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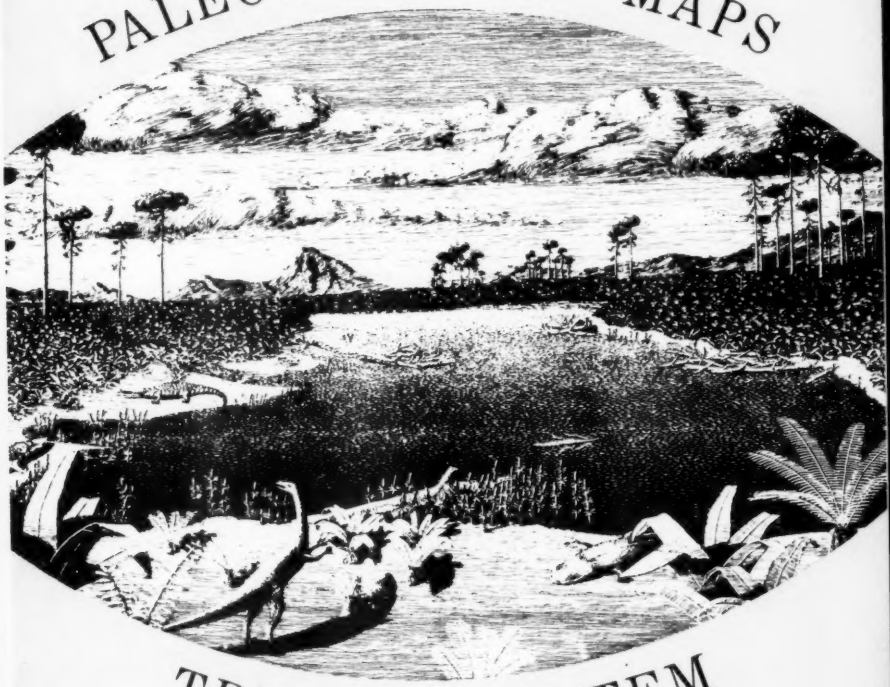

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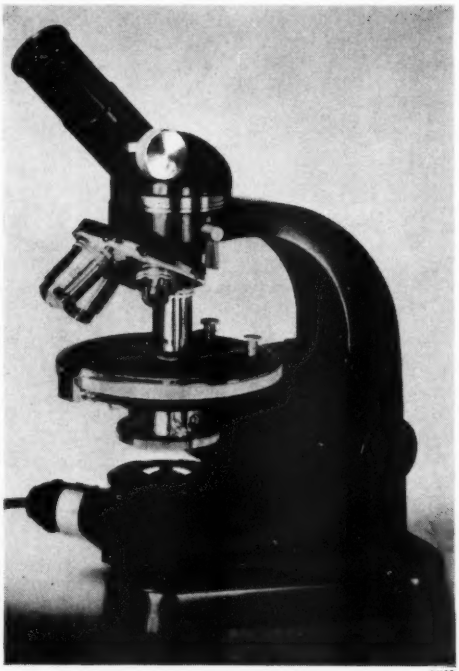

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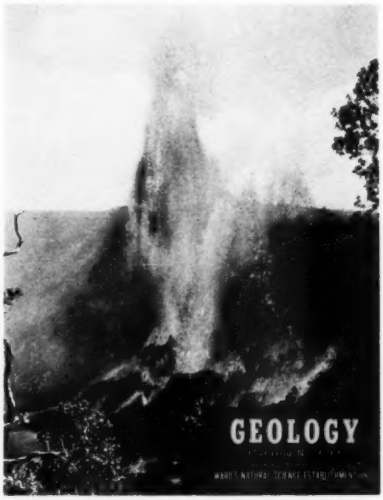

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Calendar

Cooperation of Society Secretaries in supplying meeting notices for GEOTIMES calendar is requested.

Sept. 11-16, 1960—AMER. CHEM. SOC., 138th Meeting, New York City.

Sept. 26-27, 1960—ACerS: Basic Science Division, Warren, Mich.

Oct. 2-5, 1960—AIME: Soc. of Petr. Eng., Fall meeting, Denver.

Oct. 5-7, 1960—AIME: Rocky Mountain Minerals Conf., Newhouse Hotel, Salt Lake City, Utah.

Oct. 6-8, 1960—9th NATIONAL CLAY CONF., Purdue Univ., Lafayette, Ind. Write: J. L. White, Agronomy Dept., Purdue Univ.

*Oct. 7-8, 1960—ASSOC. OF MISSOURI GEOLOGISTS, Ann. Meeting and field conf., St. Louis, Mo. Write: Dr. Kenneth Brill, St. Louis Univ., St. Louis.

Oct. 12-14, 1960—AAPG: SW Fed. of Geological Soc's., 3rd Ann. Meeting, Wooten Hotel, Abilene, Texas.

Oct. 13-15, 1960—OPTICAL SOC. OF AMERICA, Somerset Hotel, Boston, Mass.

*Oct. 14-16, 1960—CALIF. ASSOC. OF ENGINEERING GEOLOGISTS, 3rd Ann. Meeting, Univ. of Calif. at Berkeley. Write: CAEG, P.O. Box 4164, Sacramento 21, Calif.

Oct. 17-19, 1960—BIANNUAL SYMPOSIUM ON DRILLING & BLASTING, sponsored by mining dep'ts. of Univ. of Minnesota, Penn. State Univ., & Colo. School of Mines, Golden, Colo.

Oct. 18-21, 1960—ACerS: 13th Pacific Coast Regional Meeting, Ambassador Hotel, Los Angeles, Calif.

*Oct. 19-21, 1960—GULF COAST ASSOC. OF GEOL. SOC'S., 10th Ann. Convention, Buena Vista Hotel, Biloxi, Miss. Host: Miss. Geol. Soc. Theme: "The Future of Gulf Coast Oil." Technical sessions, entertainment and post meeting field trip. Write: A. E. Blanton, Gen. Chrmn., P. O. Box 422, Jackson, Miss.

Oct. 20-21, 1960—AIME: Los Angeles Basin Sect., Fall Meeting, Huntington Sheraton Hotel, Pasadena, Calif.

*Oct. 31-Nov. 3, 1960—GSA: Ann. Meeting, in conjunction with PS, MSA, GS, SVP and SEcG, Denver Hilton Hotel, Denver, Colo. Field trips before and after the meetings, also local excursions. Write: E. D. McKee, U.S. Geol. Survey, Federal Center, Denver, Colo.

Nov. 3-4, 1960—AAPG: Pacific Section, Ann. Meeting, Ambassador Hotel, Los Angeles.

Nov. 7-10, 1960—SEGp: 30th Ann. Internat. meeting, Moody Convention Center, Galveston. Write: W. B. Lee, Jr., Gulf Oil Corp., Dr. 2100, Houston 1, Tex.

Dec. 2-3, 1960—N.A.G.T., Texas Sect.—Texas Acad. of Sci.; Texas Christian Univ. Campus, Fort Worth, Texas.

Dec. 26-31, 1960—AAAS, Annual Meeting, New York City.

1961

Feb. 8-10, 1961—CANADIAN INST. OF SURV. & PHOTOGRAMMETRY, Ann. Meeting, Ottawa, Ont.

Feb. 10, 1961—12th ANN. SYMPOSIUM ON HIGHWAY GEOLOGY, University of Tennessee, Knoxville; Write: R. A. Laurence, USGS, Room 11, P. O. Bldg., Knoxville 2, Tenn.

Feb. 19-23—AIME: Annual Meeting, Chase and Park Plaza Hotels, St. Louis, Mo.

Feb. 26-Mar. 2, 1961—AIME: Soc. of Petrol. Eng., Ann. Meeting, Chase & Park Plaza Hotels, St. Louis.

Mar. 5-10—ASP-ACSM: Annual Meeting, Shoreham Hotel, Washington, D. C.

Mar. 21-30—AMER. CHEM. SOC., 139th Meeting, St. Louis, Mo.

Mar. 20-24—SEVENTH NUCLEAR CONGRESS, Chicago, Ill.

April—OHIO ACAD. OF SCIENCE, Geol. Sect., Univ. of Cincinnati, Ohio.

April 17-19—CIM: Annual General Meeting, Chateau Frontenac, Quebec City, Quebec.

April 20-21, 1961—AIME: Soc. of Petrol. Eng., East Texas-Lou.-Ark., gas technology symposium, Tyler, Texas.

April 23-27—ACerS: 63rd Annual Meeting, Royal York Hotel, Toronto, Ontario.

April 24-25, 1961—AIME: Southwest Mineral Industry Conf., Las Vegas, Nevada.

April 24-27—AAPG-SEPM: 46th Ann. Meeting, Hilton Hotel, Denver, Colo.

May 4-5, 1961—AIME: Soc. of Petrol. Eng., oil recovery conf., Midland, Texas.

May 25-26—AIME: Joint Meeting Rocky Mountain Petroleum Sects., Salt Lak eCity, Utah.

1960 SCHEDULE OF FIELD TRIPS

For additional field trips held in conjunction with meetings, see those items marked with an asterisk under meeting calendar.

Sept. 7-10—BILLINGS GEOL. SOC., trip to Hebgen Lake earthquake and Madison slide of Yellowstone Park area to study local strat. and struct.; write: Richard L. Jodry, P. O. Box 219, Billings, Montana. Guidebook.

Sept. 8-10—INTERMTN. ASSOC. OF PETR. GEOLOGISTS—E. NEV. GEOL. SOC., joint trip to Nev. only oil field and to include the geology of East Central Nevada in the Ely region. Write: Walter M. Winfrey, Box 269, Ely, Nevada.

Sept. 10-11 — FRIENDS OF THE PLEISTOCENE, field trips at Promontory Point (SP Railroad) and gravel pit in Little Cottonwood Creek area (20 mi S of Salt Lake City). Lake Bonneville stratigraphy and correlations with glacial units. Write: R. B. Morrison, U.S.G.S., Federal Center, Denver, Colo., or H. D. Goode, U.S.G.S., 503 Federal Bldg., Salt Lake City, Utah.

Sept. 16-17—KANSAS GEOL. SOC., 25th Ann. Field Conf., trip to NE Oklahoma to study Atokan, Morrow, Upper Mississippian and Pre-Mississippian exposures. Write: Soc., Attn: Jack Wheeler, 505 Union Center Bldg., Wichita, Kansas. Guidebook.

Sept. 17—ILLINOIS STATE GEOL. SURV., trip to study Devonian and Pennsylvanian strata of Milan Quarry, Rock Island County, Ill.

Sept. 29-Oct. 1—WEST TEXAS GEOL. SOC., trip to Apache Mtns. and Delaware Basin to study oil fields and Permian system; write: Eugene Greenwood, P.O. Box 1600, Humble Oil Co., Midland, Tex. Guidebook.

Oct. 1 — OHIO INTERCOLLEGIATE FIELD TRIP, trip to NW Ohio to study Paleozoic strat. and Pleistocene geology. Write: John R. Coash, Bowling Green State Univ., Bowling Green, Ky.

Oct. 1—ILLINOIS STATE GEOL. SURV., trip to quarries to collect fossils from the Millersville limestone of the Pana region, Christian County, Ill.

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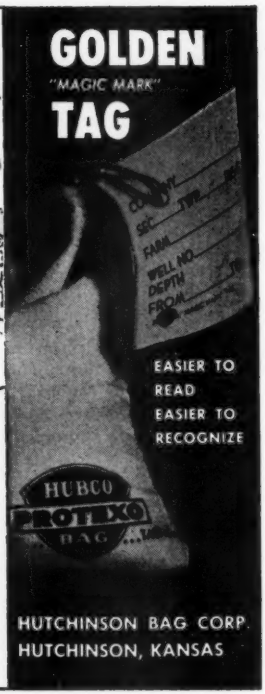

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Oct. 5-7—FOUR CORNERS GEOL. SOC., trip to E.-Cent. Utah and W. Cent. Colo. to study salt anticlines in Lisbon Valley area. Write: K. G. Smith, Box 1501, Durango, Colo., Guidebook.

Oct. 8-9—NEW ENGLAND INTERCOLLEGIATE GEOL. CONF., trip to west-central Maine to study strat. and struct. and correlation to E. New Hampshire; write: Andrew Griscom, Geophysics Branch, USGS, Washington 25, D. C. Guidebook.

Oct. 8-9—TRI-STATE GEOL. FIELD CONF., trip to north-central Iowa to study Mississippian strat. and shoreward phase of Penn. sections; write: Leo Thomas, Iowa State College, Ames, Iowa. Guidebook.

Oct. 8-9—ATLANTIC COASTAL PLAIN GEOL. ASSOC., First Ann. Field Conf., trip to Cretaceous and basal Tertiary localities in Southern New Jersey and Delaware. Write: H. G. Richards, Acad. Nat. Sci., 19th and the Parkway, Philadelphia, Pa.

Oct. 8-9—UTAH GEOL. SOC., trip to Wendover, Utah, area and NE to study Silver Island mtn. range and vicinity Great Salt Lake Desert. Write: Dr. Frederick Schaeffer, Idaho State College, Pocatello, Idaho. Guidebook.

Oct. 14-16—NEW MEXICO GEOL. SOC., trip to Chama Basin area of N.-cent. N.M. to study strat. and econ. geology of rocks Precambrian through Tertiary. Assemble at Taos, Oct. 13, disband at Cuba. Write: Clay T. Smith, N.M. Inst. Min. & Tech., Socorro, N.M. Guidebook.

Oct. 15—ILLINOIS STATE GEOL. SURV., trip to study stratigraphy and structure of Harrisburg region of Saline County, Ill.

Oct. 15—SEPM, PERMIAN BASIN SECT., trip to Brazos River Valley of N.-cent. Texas to study Post-Avis Cisco rocks strat. and sedim. Write: Richard D. Jones, Box 832, Midland, Texas.

Oct. 19-20—GULF COAST ASSOC. OF GEOL. SOCS., trip of Coastal Mississippi and Alabama to study recent marine sediments and Cenozoic. Write: A. E. Blanton, P.O. Box 422, Jackson 5, Miss. Guidebook.

Oct. 22-23—FIELD CONF. OF PENNSYLVANIA GEOLOGISTS, trip to Appalachian Piedmont along Susquehanna R. to study struct. mechanisms. Write: Dr. D. U. Wise, Franklin & Marshall Coll., Lancaster, Penna. Guidebook.

Nov. 18-20—ROSWELL GEOL. SOC., trip to south-central New Mexico to study Pennsylvanian stratigraphy. Write: M. D. Wilson, Shell, Box 845, Roswell, N.M. Guidebook.

Dec. 2-3—TEXAS ACAD. OF SCIENCE, no details.

Dec. 9-11—SOUTH TEXAS GEOL. SOC., trip to Medina and Val Verde Counties to study Cretaceous sediments with emphasis on Edwards and Glen Rose. Write: Porter Montgomery, Milam Bldg., San Antonio, Tex. Guidebook.

FIELD TRIP CALENDAR

Most of the information regarding field trips in this calendar appears through the courtesy and cooperation of the AAPG Field Trip Committee. Corrections, additions and new trip notices should be sent to George H. Fentress, Chairman, AAPG Field Trip Committee, P. O. Box 2585, Denver 1, Colo., with a carbon copy to GeoTimes Calendar, American Geological Institute, 2101 Constitution Ave., N.W., Washington 25, D. C.

This Month in GEOTIMES

Professional News Magazine

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Robert C. Stephenson, EDITOR

Kathryn Lohman CIRCULATION MANAGER

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Communication

"What science needs is not a lot of planning but a lot of convenient communication"—is a sage observation of Dr. Warren Weaver of the Rockefeller Foundation. This can be no less true for geology than it is for other sciences. As a matter of fact the matter of communications lies close to the heart of many perplexing problems in geology and of geologists.

Geology—like all sciences—has a constantly broadening horizon and the pursuit of the various frontiers of specialization on this horizon leads to an ever increasing dispersion of interests into areas of interest which are limited in scope. Specialization of interests and efforts is essential in the modern pattern of scientific growth and achievement. Specialization on the other hand poses a serious problem—that of maintaining scientific perspective and understanding of purpose which is often lost in the pursuit of specialization. It is essential that the specialist communicate his special findings to the scientific community and that the scientific community coordinate the combined and growing scientific knowledge as a guide to the individual specialist. These communications are far from ideally established in the areas of geology today.

Another facet of the communications problems of science is that of scientist-to-scientist communications about problems affecting scientists. This is the area where GeoTimes attempts to function within its restricted capabilities. GeoTimes is vitally concerned with problems affecting geologists of today and those of tomorrow. It should be doing more to focus attention on professional problems as they affect the student, the academician, the research and the applied geologist. It should further drive home the cold reality of the interrelated effects of these professional problems on all of these. The big advantage which GeoTimes offers is that its wide circulation reaches all geoscientists of all specialties including many fringe area scientists who have been attracted into the geosciences by the broad spectrum of unsolved scientific problems. The profession-wide circulation of GeoTimes is vital to the future cohesiveness of geosciences.

OUR COVER

Cover drawing of the recently published U.S.G.S. folio of tectonic maps of the Triassic System (*see books*). —*Photo by courtesy of the U.S.G.S.*

The AMERICAN GEOLOGICAL INSTITUTE is a non-profit professional service organization established and managed by the scientific societies in the fields of geology and geophysics in cooperation with the National Academy of Sciences-National Research Council. It is the instrument of the profession serving and advancing the welfare of the geoscientist in matters relating to education, professional responsibilities and government relations. It is an active member of the Scientific Manpower Commission. It also functions in the stimulation of public education and awareness of the earth sciences, through career literature, the scouting program and other channels of communication.

GEOTIMES is the news magazine of the geological sciences. It reports on current events in the earth sciences, public education and public relations efforts throughout the profession, as well as appropriate legislative and governmental issues. It announces scholarships, fellowships, publications and new developments. It provides a forum for discussion of timely professional problems, and affords a common bond between the many specialized groups within the earth sciences

THE PROGRESS OF GEOLOGY in the U.S.S.R.[1]

by S. I. TOMKEIEFF[2]

GEOCHEMISTRY

From a modest beginning inspired by V. V. Dokuchaev (1846-1903) and K. D. Glinka (1867-1927), the two prominent Russian pedologists, geochemistry in Russia has undergone not only a spectacular expansion, but also a most remarkable transformation from a gentle emphasis in the study of rocks, minerals and soils, to a definite turn towards the genetic aspect, replacing systematics as the study of static phases of a continuous process. Such was the leading trend of thought that inspired V. I. Vernadsky (1863-1945), who made geochemistry a science in Russia. It is most significant that the title of Vernadsky's first book is "An Essay in Descriptive Mineralogy" (1908), while that of his second is "The History of Minerals in the Earth's Crust" (1925). This marks the transition from the static term "descriptive" to the dynamic term "history." The greatest book, however, that Vernadsky wrote was "La Géochimie" first published in French in 1924. This book may claim to be the first systematic attempt to produce a general method of approach as well as an outline of the new science of geochemistry, as based on the new science of atomistics and the new chemistry. In it an attempt is made to shift the importance from the mineral to the atom, to regard geochemistry not merely as a "data of geochemistry," but as a dynamic science dealing with the distribution, migration and concentration of the chemical elements, as well as the formation and decomposition of minerals and the association of these minerals in rocks. An attempt was also made by Vernadsky to study the geochemical cycles of certain chemical elements. His pupil and friend A. E. Fersman (1883-1945) continued his work with a new enthusiasm and energy. It is seldom that one meets such "science-intoxicated men" as Vernadsky and Fersman! Both of them were also good and clear writers and Fersman's popular books, such as his "Entertaining Geochemistry" and his "Stories about Stones" are still graded as best sellers in the U.S.S.R. The first university course of Geochemistry ever given in Russia and perhaps in the whole world was delivered by Fersman in Moscow in 1912. In 1922 Fersman made his first attempt to provide a geochemical interpretation and synthesis of the data so far obtained in Russia in his unfinished work "The Geochemistry of Russia, Vol. I, 1922," while in his next book "Chemical Elements of the Earth and the Cosmos, 1923" Fersman cast his net far and wide.

These publications of Vernadsky and Fersman together with those of P. Niggli and V. M. Goldschmidt, published elsewhere during the same decade, are the foundation stones of the new science of geochemistry. It was 'new' because during this very decade the foundations were being laid of the new atomistics, the new leptology and the new cosmology, all within the limits of geochemistry. The new geochemistry was making an attempt to span atom to cosmos and to provide a new dynamic interpretation of all geological processes affecting such objects of ordinary experience as minerals and rocks. The dominant ideas expressed by all these authors are that matter is in a state of constant flux; that in respect of certain elements this flux is of a recurrent nature, producing the so-called geochemical cycles; that the product of these transformations, apparently stable minerals and rocks, are only temporary phases of this process and that to understand them properly one must understand first the nature and the direction of the changes and then the energy sources behind these changes. These ideas inspired Fersman to write his monumental "Geochemistry" (1934-1939), a rather bewildering book full of new data, new terms and new ideas. More compact text-books of

[1] This is the concluding portion of the article by Prof. Tomkeieff appearing in the July-August 1960 issue of GEOTIMES.

[2] SERGEI IVANOVICH TOMKEIEFF, University of Durham, King's College, Newcastle upon Tyne 1, England.

geochemistry have been written by V. V. Shcherbina (1959) and A. A. Saukov (1951).

The initial pioneering work of Vernadsky and Fersman produced a tremendous development of geochemistry in the U.S.S.R. Both Vernadsky and Fersman greatly contributed to this development. Fersman, for example, made a detailed study of various minerals collected from widely separated regions. In addition he produced an outstanding study of granite pegmatites, a work continued by K. A. Vlasov and others. In the light of geochemical processes, hydrothermal ore deposits were studied by A. N. Zavaritzky, S. S. Smirnov and A. G. Betekhtin; hypogene processes and products by B. B. Polynov and I. I. Ginzburg; and biochemical processes and products by V. I. Vernadsky, Y. V. Samoilov and A. P. Vinogradov. I. I. Ginzburg and K. I. Lukashev have produced valuable works on the crust of weathering: A. P. Vinogradov has published very valuable works on the contents and distribution of chemical elements in organisms and soils: V. V. Cherdyntzev published a book in 1956 on the distribution of the chemical elements. Detailed studies of the geochemical cycles and on the migration of chemical elements have been published. Fundamental hypotheses on the structure of the earth and on the energy sources of the geochemical processes have been advanced by A. F. Kapustinsky as well as by N. V. Belov and V. I. Lebedev who proposed an original hypothesis based on the crystallochemical features of certain elements present in the earth's crust. Attention has been drawn by A. A. Saukov to certain directed geochemical processes, such as those depending on the progressively diminishing quantities of radioactive elements in the earth's crust, or those depending on the appearance of the biosphere and the concomitant liberation of the free oxygen in the atmosphere. Valuable research on the geochemistry of separate elements has been carried out, by Vernadsky on carbon, manganese and oxgyen; by Vernadsky, V. G. Khlopin and I. E. Starik on the radioactive elements; by A. A. Saukov on mercury, and by many others. During the last decades valuable work has been done on the natural isotopes of oxygen, sulphur and carbon by A. P. Vinogradov, A. V. Trofimov and R. V. Teis. An enormous development has taken place in the application of geochemistry to other sciences, especially in the field of geochemical prospecting. Various methods of geochemical prospecting are now employed in the U.S.S.R. — metallometric, hydrochemical, biogeochemical, gas-geochemical, luminescence-bituminous and others. A comprehensive book on the methods of geochemical prospecting was published by I. I. Ginzburg in 1957.

Geochemistry is now an integral part of many branches of geology, such as mineralogy, petrology, the science of ore deposits, hydrology and even geography. Thus B. B. Polynov and A. I. Perelman, in their interesting books on this subject, discuss "geochemical landscapes," while in stratigraphy the term "historical geochemistry" is used.

Geochemical research is carried out by all universities and a large number of research institutes, the most important of which is the Institute of Geochemistry and Analytical Chemistry of the Academy of Sciences of the U.S.S.R. Since 1957 the Academy of Sciences has published a journal entitled "Geokhimiya."

Crystallography

The Russian school of crystallography dates from Axel Gadolin (1828-1892), who in 1863 without knowledge of the work of Hassel and Bravais derived in a simple and most elegant way the 32 point-groups. During the same period crystal goniometry in Russia was greatly advanced by N. I. Koksharov (1818-1892) and P. V. Eremeyev (1830-1899). But it was E. S. Fedorov (1853-1919) who was the most outstanding Russian crystallographer. His theory of crystal structure, his discovery of 230 space-groups, his invention of the two-circle goniometer and of the universal stage, are all well known throughout the world. The first Russian scientist to introduce X-rays to the study of crystals was G. V. Wulff (1863-1925), who shares with W. H. and W. L. Bragg the honour of having discovered the fundamental X-ray structural formulae. Fedorov's prominent pupils were O. M. Ansheles (1885-1957) and A. K. Boldyrev (1883-1946), and at the second remove—G. B. Bokii and I. S. Shafranovsky, while Wulff's two prominent pupils are A. V. Shubnikov and E. E. Flint.

The modern Russian school of crystallography is very vigorous and most original. It is dispersed among various sciences, such as mineralogy, metallurgy, physics, chemistry and geochemistry. Research in crystallography is carried out in various institutions and universities, but the principal centres of reseach are the Institute of Crystallography and the Fedorov Institute. The Institute of Crystallography is directed by A. V. Shubnikov. In 1925 Shubnikov became the head of the crystallography department of the Mineralogical Museum of the Academy of Sciences. This department in 1938 was transformed into the Laboratory of Crystallography, and again

in 1945 into the Institute of Crystallography. Shubnikov's research in crystallography began in 1911. He became interested in the structure of crystals and in 1922 he published an important work on the relation between the chemical composition of crystals and the symmetry groups. Later he worked on the growth of crystals, on the crystallography and properties of quartz and on the piezoelectric properties of crystals. In 1947, in collaboration with Flint and Bokii, he published a book entitled "The Principles of Crystallography" and in 1951 he published a most original and novel contribution to geometrical crystallography in a book entitled "Symmetry and Antisymmetry of Finite Figures." The main research on the structure of crystals by X-ray methods was carried out by N. V. Belov, who became the leader in this field. Besides a large number of publications with co-workers on the structure of individual minerals, Belov himself has published two important books—"Structure of Ionic Crystals and Metallic Phases" in 1947 and "Structural Crystallography" in 1951, as well as an article entitled "The Structure of Silicates" in 1957. The electronographic work in the Institute of Crystallography is carried on by Z. G. Pinsker and B. K. Vainstein, the work on the physical properties and growth of crystals by G. S. Lemmlein. Work is also being carried out on piezoelectric crystals, twin crystals, colouration, optical properties, and goniometry. The Institute took the initiative of founding in 1956, a special journal entitled "Crystallographiya." Another important centre of crystallographic research is the Fedorov Institute. It was founded through the efforts of A. K. Boldyrev. Prominent workers associated with this institute were O. M. Ansheles (1885-1957) and V. I. Mikheev (1912-1956), and at the present time V. V. Dolivo-Dobrovolsky and I. I. Shafranovsky.

Recent Russian books on crystallography include the following:

Kitaigorodsky, A. I., 1950.
X-Ray Analysis.

Ansheles, O. M., 1952.
Principles of Crystallography.

Flint, E. E., 1952.
Principles of Crystallography.

Bokii, G. B., 1954.
Introduction to Crystallography.

Kuznetzov, V. D., 1954.
Crystals and Crystallization.

Popov, G. M. and Shafranovsky, I. I., 1955. Crystallography.

Shafranovsky, I. I., 1957.
Crystals of Minerals.

Mineralogy

As already noted in the preface, the industrial revolution in Russia in the 18th century was mainly directed to mining and metallurgy, and this in its turn encouraged the growth of mineralogy as a science. M. V. Lomonosov (1711-1765) was greatly interested in mineralogy, but his project of writing a "General Mineralogy of Russia" remained unfulfilled. The first great Russian mineralogist V. M. Severgin (1765-1826), besides translating Richard Kirwan's "Elements of Mineralogy," wrote a number of original books on mineralogy, including a mineralogical dictionary published in 1807. The first Russian Mineralogical Society was founded in 1817 in St. Petersburg. At that time the name "geology" was still in little use and thus mineralogy covered much of the ground covered now by the term "geology." This tradition has been carried on by the Mineralogical Society right up to the present time, and in the publications of the Society may be found many valuable contributions to petrology and other branches of geology. The Mineralogical Society is associated with such names as S. S. Kutorga (1805-1861), N. I. Koksharov (1818-1892), P. V. Eremeev (1830-1899), A. P. Karpinsky (1847-1936), E. S. Fedorov (1853-1919), F. Y. Loewinson-Lessing (1861-1939) and A. A. Inostrantzev (1843-1919).

A new period in the history of Russian mineralogy was inaugurated by V. I. Vernadsky (1863-1945), who taught mineralogy in Moscow University from 1890 to 1911. As already mentioned Vernadsky's chief contribution to science is that he placed mineralogy on a genetic basis and incorporated it in the science of geochemistry. Vernadsky's inspired work was followed up by A. E. Fersman, Y. V. Samoilov and others. Fersman was a great and versatile mineralogist and a great traveller, and he described minerals from many parts of the U.S.S.R.

Very briefly here is a list of aspects of mineralogical research in the U.S.S.R.

A large number of methods of study are used, e.g., morphological, optical, chemical, X-ray, electronographic, spectrographic, thermal. New apparatus is constantly described. Crystal morphology is constantly studied by gonimetric methods. Fine structure of minerals is studied by means of X-rays and electronography. N. V. Belov may be mentioned here. Thermal methods of study of minerals are much developed. Topographic mineralogy is also highly developed and so is the work on particular groups of minerals, for example a book on

the uranium minerals by M. V. Soboleva and I. A. Pudovkina, on the chloritic minerals by D. P. Serduchenko, and many collective works on clay minerals. On the subject of genesis of minerals there are countless publications. Two aspects are usually considered, field occurrence and paragenesis and the experimental study of the conditions of formation of minerals. Vernadsky and Fersman must be mentioned here in the first instance, followed by N. M. Fedorovsky, G. A. Betekhtin, V. A. Nikolaev and D. S. Korzhinsky. D. S. Belyankin, V. P. Petrov, N. M. Strakhov and E. K. Lazarenko have discussed the genesis of clay minerals. Colloidal minerals have been recently discussed in great detail in a book by F. B. Chukhrov. There are a very large number of publications describing minerals and during the last forty years over two hundred new minerals have been discovered and named. Among new textbooks of mineralogy are those by G. A. Betekhtin (1950, 1956), E. K. Lazarenko (1951) and V. S. Sobolev (1949). Various new schemes of classification of minerals have been proposed by I. Kostov, G. B. Bokii and A. S. Povarennykh. The principal publications devoted to mineralogy are the *Memoirs (Zapisky) of the All-Union Mineralogical Society, Transactions of the Mineralogical Museum of the Academy of Sciences,* and the *Mineralogical Magazine (Sbornik)* published by the Lvov Geological Society.

Meteoritics

Meteoritics has been cultivated in Russia ever since the discovery of the iron meteorite in Siberia by P. S. Pallas in 1772. This meteorite was described in a book published by E. F. Chladni, a corresponding member of the Russian Academy of Sciences, in Riga in 1794. The first Russian treatise on meteorites entitled "On Aerial Stones and their Origin" was published by A. Stoikovich in Kharkov in 1807. Since then a number of distinguished Russian scientists, such as V. I. Vernadsky and A. E. Fersman, have busied themselves with meteorites. The most prominent among the recent workers in this field were L. A. Kulik (1883-1920), P. L. Dravert (1879-1945), P. N. Chirvinsky (1880-1955) and A. N. Zavaritzky (1884-1952). At the present time the leading workers are V. G. Fesenkov and E. L. Krynov. The most important recent books on this subject are: A. N. Zavaritzky and L. G. Kvasha, "Meteorites of the U.S.S.R.," 1952, E. L. Krynov, "Meteorites," 1948, and E. L. Krynov, "Principles of Meteorites," 1955. A periodical "*Meteoritica*" is published in Moscow. A very full collection of abstracts of Russian publications on meteorites, written and edited by L. J. Spencer, is to be found in the *Mineralogical Abstracts* (1920-1959) published by the Mineralogical Society of London.

Experimental Mineralogy and Petrology

Experimental mineralogy and petrology were cultivated in Russia long before the October Revolution. It is sufficient only to mention K. D. Khruschev (1852-1912), A. E. Lagorio (1852-1925) and I. A. Morozevich (1865-1941) to realise the value of the results achieved in this field of study. It was particularly well advanced in the St. Petersburg Polytechnical Institute, where the work was carried out by N. S. Kurnakov (1860-1941), F. Y. Loewinson-Lessing (1861-1939), D. S. Belyankin (1876-1953), P. I. Lebedev (1885-1948) and A. S. Ginzberg. After the revolution this work greatly expanded. The Experimental Institute of Silicates was founded in 1918, the Ceramic Institute in 1919, the Institute of Applied Mineralogy in 1923, the Institute of Building Materials in 1931, and the Institute of the Chemistry of Silicates in 1945. Besides these institutes the work was carried out in many other institutions, such as the Laboratory of High Temperatures at V.S.E.G.E.I., the Institute of Physico-Chemical Analysis, the Mining and Metallurgical Laboratory, the Institute of General and Inorganic Chemistry, the Institute of Geological Sciences and many others. The work carried out in these institutions comprises the investigation of natural mineral products used in industry and industrial products such as refractories, ceramics, glass, cement, slags and cast basalt. A great amount of work is on artificial "dry" and "wet" melts, phase rule studies, thermography and a multitude of other types of research. Among many workers in this field of research are A. N. Zavaritzky, D. S. Belyankin, V. V. Lapin, D. P. Grigoriev, N. I. Khitarov and M. P. Volarovich. Five conferences of experimental mineralogy and petrology have been held in 1934, 1936, 1939, 1952 and 1956. The report of the last conference, published in 1958, contains fifty-three papers dealing with various subjects.

Books on experimental mineralogy and petrology are very numerous and here is a small selection:

Berg, L. G., and others, 1944. Thermography.

Budnikov, P. P., and Berezhnoy, A. S., 1949. Reactions in Solid Phases.

Tzvetkov, A. I., and others, 1949. Materials for the Thermo-analytical Studies of Minerals.

Ermakov, N. P., 1950. Studies of Mineral-forming Solutions.
Belyankin, D. S., Lapin, B. V., Ivanov, B. V., and Lapin, V. V., 1952. The Petrography of Technical Stone.
Lapin, V. V., 1956. The Petrography of Metallurgical Slags and Clinkers.
Belyankin, D. S., 1956. Selected Works, Vol. I.

The last mentioned book deserves special notice. In this volume of over 800 pages, 108 articles written by Belyankin deal with original research on artificial minerals, silica bricks and other refractories, commercial glass, etc., and they are rich in numerical data.

Petrology of Igneous and Metamorphic Rocks

Before the Revolution petrology in Russia was studied by comparatively few people and those, for the most part, grouped round the school of F. Y. Loewinson-Lessing at the St. Petersburg Polytechnical Institute. Loewinson-Lessing was world famous as a petrologist, but he was also an inspirer and leader of several generations of Russian petrologists, as well as being a versatile scientist in other fields. His earlier works on the Olonetz diabase formation, on the volcanoes and lavas of the Central Caucasus and his "Essays on Theoretical Petrology" published in 1898, are recognized classics of the science, while his four decades in the present century are marked by a large number of high class works on geology and crystallography and some laboratory manuals, in addition to books and articles on his own particular subject, petrology. In the latter field his work ranges from experimental thermal works, magnetisation of rocks and descriptive petrology to discussions of the nature of primary magma and the origin of igneous rocks. In 1930, in collaboration with Z. N. Nemova, he published a very large folio containing a collection of analyses of Russian metamorphic and igneous rocks. In 1937, in collaboration with E. A. Struve, he published a petrographical dictionary. His book on the history of petrology was published in an English translation in 1954. He will also be remembered for his works on the igneous rocks of Crimea and the Caucasus, especially on the lavas of Armenia. In this work he was followed by many petrologists, one of them, P. I. Lebedev, producing a very detailed description of a lofty Armenian extinct volcano—Alagoz. His friend and sometime colleague, D. S. Belyankin, whose works on experimental mineralogy and petrology were mentioned above, was also very active among the Caucasian igneous rocks. Igneous rocks of other regions, like those of the Ukraine, the Urals, Karelia and especially the newly discovered alkaline rocks of the Kola Peninsula, attracted much attention. B. M. Kupletsky, for example, published a number of papers dealing with the alkaline rocks and also produced an important monograph on the Russian nepheline-bearing rocks in 1936. V. N. Lodochnikov published a large monograph of over 800 pages entitled "Serpentines and Serpentinites" in 1936. A number of works on petrology were published by the outstanding Russian petrologist A. N. Zavaritzky (1884-1952) including "Mount Magnitnaya" (1922, 1927), "Peridotite Massif of Rai-Iz in the Polar Urals" (1932), "Berdyaush Pluton in the Urals" (1937), "Petrochemistry of Igneous Rocks" (1944) and a textbook of igneous rocks (1956). Besides these Zavaritzky published a number of works dealing with various igneous rocks, Uralian iron and copper ores, the volcanoes of Kamchatka and meteorites. Regional studies in petrology are obviously too numerous to be mentioned here, but the sort of work being done can be illustrated from one region—the vast territory of Siberia. We have here a very varied and interesting field for regional petrographic research, e.g., Siberian Traps petrographical province of Central Siberia, kimberlite pipes and diamond deposits, a book on diamond fields of Siberia, by A. V. Burov and V. S. Sobolev (1957), alkaline ultrabasic rocks with their associated carbonatites (L. S. Borodin, Y. M. Sheinmann), and the granites of the Far East and other plutonic complexes. Of particular interest is the progress of research on the volcanoes of Kamchatka, and, since 1945, on the volcanoes of the Kurile Islands. The Kamchatka Volcanological Station was founded in 1935 and the Laboratory of Volcanology in 1939. The purpose was to study, in great detail, the twenty active and the hundred or more extinct volcanoes of Kamchatka. At the present time this research is being done under the directorship of V. I. Vlodavetz. The bulk of the work is published in the *Transactions of the Laboratory of Volcanology* and the *Bulletins of the Volcanological Station*. (S. I. Tomkeieff, The Volcanoes of Kamchatka, *Bull. Volcan.* 1949, ser. 2, fol. 8, p. 87.)

A few petrologists associated with specific research lines are:—A. G. Komarov, palaeomagnetism and polar wandering; N. A. Eliseev, structural petrology; D. S. Korzhinsky, problems of metamorphism and metasomatism; G. D. Afanasiev, V. P.

Petrov, Caucasian igneous rocks; K. A. Vlasov, granite pegmatites; Y. A. Kuznetzov, P. N. Kropotkin, V. A. Nikolaev, N. I. Khitarov, granites, granitization, magmatic and migmatic problems.

Before the war petrographical work was centered in the Petrographical Institute, which published a large proportion of its research results. This institute has now been incorporated into the Institute of the Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry.

Petrology of Sedimentary Rocks

The wide development of the petroleum and coal industries and the increased exploitation of sedimentary iron ores, phosphates and building stones, served as stimuli to the development of the petrology and petrogenesis of sedimentary rocks, or "lithology" as the Russians prefer to call this science. Before the Revolution there were a few fine publications on this subject, such as the works on clays and clay minerals, by P. A. Zemyatchensky, K. D. Glinka and I. I. Ginzburg; on phosphates by Y. V. Samoilov and P. N. Chirvinsky; on modern marine deposits by N. I. Andrusov; and on the crust of weathering by B. B. Polynov. After the revolution there was first a period of accumulation of new data and a reorientation of ideas; then a new era in lithology began with the publication in 1932 of a book on the facies of sedimentary rocks by D. V. Nalivkin, followed by an introductory text book on sedimentary rocks by A. N. Zavaritzky and a fuller text book by M. S. Shvetzov. The same year witnessed the first attempts by L. V. Pustovalov and N. M. Strakhov to produce a unified science of lithology by incorporating genetic sedimentology and geochemistry, together with sedimentary petrology with an emphasis on the genetic aspect. There was an appeal for more research on the conditions of sedimentation, sedimentary differentiation and diagenesis in modern seas, in lakes and on dry land. Inspired by the work of Vernadsky and Samoilov, the sedimentologists paid more attention to the conditions of formation of deposits of organic origin, or those formed through the intervention of organisms.

The post-war years have witnessed a brilliant and rather turbulent development of lithology cum lithogenesis. The rapid accumulation of a large amount of data has led to a series of wide generalizations and genetic speculations. At the same time detailed work has proceeded on separate groups of sedimentary rocks and sedimentary formations, such as clays and clay minerals (numerous authors), manganese ores (A. G. Betekhtin and N. S. Shatsky), phosphorites (A. V. Kazakov and N. S. Shatsky), and carbonate rocks (N. M. Strakhov).

There have been many different approaches to the study of sedimentary rocks and sedimentary minerals, for example, heavy minerals as pointers to the sources (V. P. Baturin), complex mineralogical-petrographical description, environment and facies (L. V. Pustovalov), historiogenetic, physico-chemical, comparative lithological (A. D. Arkhangelsky), geochemical, modern sediments and the process of their formation, and finally mathematical-statistical (A. B. Vistelius, A. B. Ronov). This last method has been highly developed in the U.S.S.R. as in the estimation of volumes of definite types of deposits laid down during a definite geological period over a definite area. The data thus obtained are then used as a basis for the construction of genetic or geochemical cycles of sedimentation. For example Vinogradov and Ronov have produced large-scale statistical surveys of the carbonate, argillaceous and arenaceous sedimentary rocks of the Russian platform, while Ronov and Khain have produced world surveys of the deposits of the Devonian, Carboniferous and Permian periods. Ronov has also published a detailed survey of the carbonate rocks of the Palaeozoic age as developed on the Russian platform, illustrating his text by most original lithological-geochemical maps.

The most controversial part of lithology is obviously its genetic aspect. L. B. Pustovalov first expressed his views in his book "The Petrography of Sedimentary Rocks," published in 1940, and N. M. Strakhov in 1948 discussed this question in his book "Principles of Historical Geology." Both of these authors are keen to find regularities in the accumulation and distribution of the sedimentary deposits, but Strakhov is more emphatic in the application of the results of study of modern sediments to the study of ancient formations.

Applied Geology

A glimpse of the initial progress of mining and metallurgy in Russia was given in the introduction. Steady progress was made in the prospecting, extraction and study of the mineral deposits and the increased demand for metals and other products during the first world war. After the Revolution an additional stimulus was provided, rapid development; numerous expeditions resurveyed old deposits and discovered rich new ones. One, led by A.

E. Fersman, found enormous deposits of apatite and nepheline and various metallic ores in the Kola Peninsula; the magnetite deposits of the Urals were re-examined and resurveyed by A. N. Zavaritsky, 1922-1927, and in 1925 P. I. Preobrazhensky and others found very large deposits of potash salts in the upper Kama region. Many other valuable deposits were brought to light during this period.

Important landmarks in the study of ore deposits were the publication in 1926 of a book on the metallogenic epochs and provinces of Siberia by V. A. Obruchev; of an article on the classification of magmatic ore deposits by A. N. Zavaritzky; and of the first study of pegmatites by A. E. Fersman, which he followed by a much larger publication on the same subject in 1931. The work on metallogenic epochs and provinces was followed up by S. S. Smirnov and Y. A. Bilibin and lead to a large scale survey of the U.S.S.R. for the purpose of the construction of special "metallogenetic maps." Smirnov was alsc responsible for the discovery of important tin deposits in the Far East and for the study of hydrothermal deposits. The hydrothermal deposits were also discussed by V. A. Nikolaev and A. G. Betekhtin in a volume entitled "Fundamental Problems in the Study of Magmatogenic Ore Deposits," edited by A. G. Betekhtin and published in 1953. This volume also contains valuable articles on colloidal solution in ore deposition by O. D. Levitzky, and a discussion of metasomatic processes by D. S. Korzhinsky who has also written much on the skarn ores.

Much work has also been done on other mineral deposits. In the region of the so-called "Kursk magnetic anomalies" valuable iron ores have been recently discovered and described, while chromite ores associated with the ultrabasic rocks in the Urals were studied by A. G. Betekhtin and P. M. Tatarinov. A great deal of attention was also paid to mineral deposits associated with the crust of weathering, such as clays, bauxites and iron ores, sedimentary ores of various kinds including salt deposits, which latter are discussed in a book by A. A. Ivanov, published in 1953.

As regards coal, much work has been done on the old well known localities, like the Donetz and the Kuznetzk Basins, and also on more recently discovered deposits, such as those of Vorkuta, Karaganda, Tungusska, Yakutia, and on the brown coal deposits of the Far East, Urals and Georgia. The work on the chemistry and micropetrology of coal, which was originally carried out by M. D. Zalessky, was taken over by Y. A. Zhemchuzhnikov and a large number of other workers. The sedimentary environment of coal, its genesis and distribution in space and time were studied by M. M. Prigorovsky and P. T. Stepanov (*Fuel*, 1949, 28, 159). Petroleum and natural gas reserves, well known to occur in the Caucasus, were discovered in many other places in the U.S.S.R., for example in the Ural-Volga region, nicknamed the "Second Baku". Work on petroleum and other bitumens has been carried out by a very large number of geologists, including I. M. Gubkin, N. D. Zelinsky, N. B. Vassoevich and V. A. Uspensky.

Engineering geology, including hydrogeology and soil mechanics, has been the subject of much research. Text books on engineering geology were published by F. P. Savarensky in 1939, and by O. A. Alekhin in 1953, on soil mechanics by V. A. Priklonsky, on the permanently frozen ground by M. I. Sumgin, on hydrochemistry by O. A. Alekhin and on radio-hydrogeology by A. N. Tokarev and A. V. Shcherbakov.

History of Geology

The modern period in the study of the history of geology in the U.S.S.R. began with the publication in 1921 of a book on the history of geology by A. P. Pavlov. This was followed in 1923 by a very full account of the progress of petrology in Russia by Loewinson-Lessing. Then in 1931-1939 V. A. Obruchev published his detailed account of the geological investigations of Siberia. In 1936, going beyond the confines of the U.S.S.R., Loewinson-Lessing published his historical survey of petrology, the English translation of which appeared in 1954. Another great Russian geologist N. S. Shatsky also became interested in the history of geology and in 1941 he published a most interesting book on the life and work of the great British geologist R. I. Murchison, who had done so much for the progress of geology in Russia. In 1949 D. P. Grigoriev and I. I. Shafranovsky published a book on famous Russian mineralogists. L. S. Davitashvili, in 1948 published a book on the history of evolutionary palaeontology from Darwin to our days, and A. V. Khabakov in 1950 an essay on the history of geological prospecting in Russia, a subject which in 1956 received much fuller treatment in a book by F. D. Bubleinikov. Finally V. V. Tikhomirov and V. E. Khain in 1956 produced a "Short outline of the history of

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INDIAN TECHNICAL[1] MANPOWER

Geo-Scientists

A large country with vast untapped mineral and other natural resources needs the services of a large contingent of geological and allied scientists. Most of India's mineral resources are unexploited, and in many fields they are not fully surveyed. The quality of Indian minerals is known to be the best in a number of instances like iron ore, mica, coal and bauxite. Only in recent years have we come to know of the possible petroleum deposits in the various parts of the country. A good deal of work has to be done on its prospecting. Uranium has opened yet another important and fruitful field of investigation. Prospecting of coal and lignite will have to continue for many years for the assessment of the exact extent of these power resources. It is needless to stress the importance of prospecting the mineral resources in India. Mineral output in 1956 valued at Rs. 125.5 crores accounted for 1.2% of the net national income of India. The possibilities are great in this direction, and the country's well-being and industrial advancement chiefly depend upon the accelerated development programme of mineral resources. In the First Five Year Plan Rs. 1 crore was allocated for mineral development The allocation is Rs. 73 crores in the Second Plan.

Large numbers of trained geologists and geophysicists are needed in a country of a million and a quarter square miles of land formation. Geo-scientists are needed not only for mineral prospecting, but also for other purposes like river development planning, deciding on location of dams, ground-water investigation, etc. We have probably only 1700 geologists of post-graduate qualification in the country, not all of whom are gainfully employed. This is a meagre resource in geological manpower. The annual out-turn of post-graduate geologists stands at about 150.

Geophysics is a comparatively new subject introduced in the Indian Universities. The statistics of the Education Ministry indicate an annual output of 18-26 in the last few years. The total strength of geophysicists in the country may not exceed 200.

Useful geo-scientists cannot be produced merely by educating them through universities. Field work is the key to success. For any long-term view, all the available forces must be fully utilized in the field immediately. There are also B.Sc. level persons with basic training in geology who would make practical geologists if they are given the opportunity.

In 1951, the U. S. A. had over 12,000 geologists and 8,000 geophysicists. Generally speaking, 40% of the professional or practicing geologists held post-graduate and 60% first graduate degrees. Nearly one-third of the geophysicists were of post-graduate qualification, and two-thirds held the first degree. By 1956, the strengths of geologists and geophysicists were estimated at about 15,000 and 10,000 respectively, giving a total of 25,000. At present the total may stand at about 30,000.

India has about one geo-scientist for every 660 sq. miles of the country, while the U. S. A. has one for every 110 sq. miles.

Russia's training programme for geo-scientists appears to be substantially bigger than that of the U. S. A. The Soviet institutions of higher education turned out 11,000 geo-scientists in 1955, while America produced about 4,00 in the same year.

The rate at which geo-scientists are utilized in a country is an index of effective planning of the industrial and strategic materials.

Geological survey and mineralogical prospecting are long and painstaking processes. Wider and more thorough investigations lead to better assessment and optimum operation of the resources.

Shortage of geo-scientists will be felt for the execution of a more accelerated programme. It may, in that case, be necessary to find ways and means, not only to turn out more geologists and geophysicists, but also to make use of the personnel with training in Geography (over 5,000 with post-graduate degrees), a class of geo-scientists hitherto practically untapped for any useful field work. It appears that they can be judiciously attached to certain work where geologists need not be wasted, so that the entire team can be effectively strengthened.

Geologists and Geophysicists

Nearly half of the country's geologists and geophysicists of post-graduate level have been enrolled in the National Register in course of a year. The general break up of the registrants is as follows:

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[1] A reprint of the articles Geo-Scientists and Geologists and Geophysicists appearing in Technical Manpower, Bulletin of the National Register CSIR New Delhi, vol. I, no. 7, July 1959, published by K. Ray, the National Register, CSIR, Old Mill Road, New Delhi.

COESITE CRATERS and SPACE GEOLOGY*

W. T. PECORA**

The term "Space Geology," admittedly a hybrid term, has nevertheless received the sanction of current usage among geologists to signify the extension to extraterrestrial objects and domains of those concepts and techniques of study hitherto employed in geology, the study of the earth.

The recent discovery of coesite, a high pressure polymorph of silica, at Meteor Crater, Ariz., reported in *GeoTimes* in the preceding issue (p. 37) and by Chao, Shoemaker, and Madsen in *Science*[1] can be of great significance in recognizing impact craters on earth caused by meteoritic falls. Coesite had been known only as a dense form of silica synthesized in the laboratory; and a determined search for a natural occurrence was culminated by its discovery in sheared Coconino sandstone by the U. S. Geological Survey in June of this year.

EXPERIMENTAL DATA

Coesite was first made in 1953 by Dr. Loring Coes, Jr., in the laboratory of the Norton Company, Worcester, Mass. Working systematically and without fanfare, Dr. Coes succeeded in synthesizing a great many complex mineral substances, among them a high density form of silica now known as coesite in his honor. He produced this compound at pressures of about 35 kilobars and in the temperature range of 500°-800° C. Those of us who heard Coes speak of his experimental results, or who visited his laboratory, were impressed with his humility and his dogged persistence in creating one mineral after another in his specially designed high pressure apparatus.

MacDonald (2), working as a guest at U.C.L.A. in 1955, repeated Coes' success in synthesizing coesite by using the high-pressure "squeezer" designed by Griggs. At the "Bush Conference" in the Fall of 1955, MacDonald presented to members and guests of the Geophysical Laboratory a theoretical discussion of the quartz-coesite equilibrium and the possible existence of rocks at great depth in the crust that are chemically equivalent to granite or basalt but composed of denser mineral phases than, for example, those characteristic of rocks at shallower depth or at the surface. Led by this suggestion, perhaps, a general search for coesite in eclogitic rocks was made but without success. More recently, Dachille and Roy[3] of Pennsylvania State University and Boyd and England[4] of the Geophysical Laboratory synthesized coesite and redetermined the quartz-coesite equilibrium curve over a wide range of temperatures and pressures.

From the accumulated evidence of the experimentalists, it seemed unlikely that coesite could form at anything but very great depths in the earth. It would be expected to invert to a less dense form of silica enroute to the surface in geologic time.

Shock experiments on single crystals of quartz by De Carli and Jamieson[5] failed to produce coesite at pressures of 380 kilobars (calculated) but changed the quartz to an isotropic substance having many of the properties of a glass. Passage of shock waves through substances can locally raise the pressure much higher than can be reached with present static load devices. Unfortunately shock wave pressures have

* Publication authorized by the Director, U.S. Geological Survey.

** Geologist, U.S. Geological Survey.

durations of milliseconds and the actual pressure cannot be measured directly but must be calculated. The mystery lies in the realization that if up to 380 kilobars under shock conditions in the laboratory coesite was not formed from quartz, how was it formed at Meteor Crater? Coesite was also looked for but not found in rocks at nuclear explosion craters and in specially designed laboratory experiments involving hypervelocity impact, where high pressure shock waves were also generated.

Natural Occurrence

Coesite, quartz, and fused silica glass coexist in specimens of sheared, porous, Coconino sandstone at Meteor Crater. Coesite is concentrated on quartz grain boundaries and in fractures in quartz grains. If the composition of the glass (lechatelierite) could be accurately determined, one could estimate the approximate minimum temperature necessary to sinter the rock. The pressure parameter, unfortunately, cannot be estimated from the equilibrium curves because if, as suggested by petrographic relations, the transformation of quartz to coesite preceded the wholesale sintering phenomenon, we are dealing with a shear phenomenon of very short duration followed by a peak in the thermal reaction. The very high pressures required to transform quartz to coesite (above 20 kilobars) could thus have been induced at grain to grain contacts through the general action of a shearing force induced by severe shock.

The abundance of coesite-bearing sandstone fragments within the crater and as fall-out debris in the vicinity around the crater nevertheless points up the mechanics of transformation of quartz to coesite as a force of first order magnitude. If this force was imparted by the passage of a shock wave generated by the impact of a meteorite, the mineral transformation must still have been made in the matter of a fraction of a second.

Shoemaker [6] in his structural analysis of Meteor Crater made a special study of the "inverse stratigraphy" and fall-out debris in and around the crater. From his observations he is convinced that the significant features are best explained by shock wave phenomena. Dietz [7] reached a similar conclusion to explain shatter cone structures produced in meteorite impact craters. Solution of the mystery of coesite formation by shock involves reaction rate, duration and peak of the shock wave, secondary wave effects, temperature gradient, and brecciation phenomena. And faith! Intuitive reasoning will eventually find the key to the mystery that has stimulated timely research by Shoemaker, Chao, Dietz, and many others.

Figure 1. Air photo of Meteor Crater (courtesy John S. Shelton, Claremont, California).

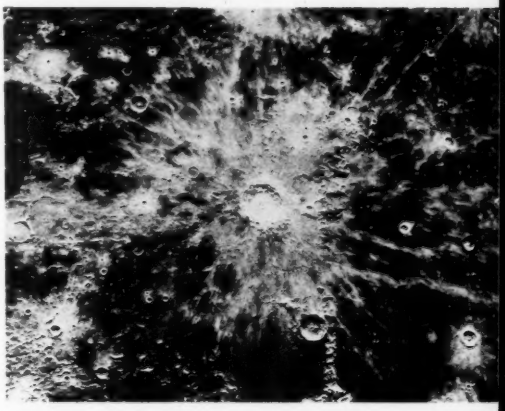


Figure 2. View of the lunar crater Copernicus taken from the 100-inch telescope at Mount Wilson Observatory (courtesy Mount Wilson Observatory). Copernicus is 56 miles in diameter, about 11,000 ft. deep and with a rim about 3,300 ft. high.

Account of Discovery

About three years ago, E. M. Shoemaker of the U. S. Geological Survey remapped Meteor Crater in connection with his study of cryptovolcanic structures and nuclear explosion craters on behalf of the Atomic Energy Commission. During this study the Barringer Crater Company, owner of Meteor Crater, permitted his access into the pit, and acquisition of specimen material—a rare privilege. The similarity between nuclear explosion craters and Meteor Crater led Shoemaker to the development of his philosophy of impact mechanics that was presented as part of his doctor's dissertation at Princeton University.

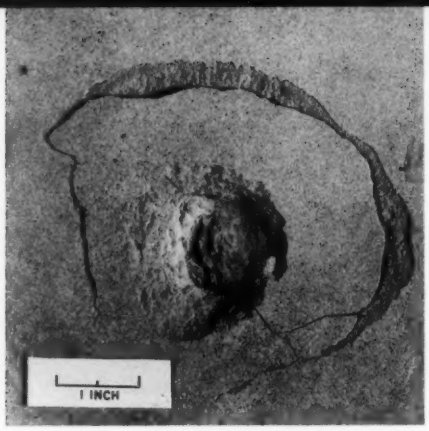


Figure 3. Experimental crater formed by hypervelocity impact. Work undertaken under arrangement between the U. S. Geological Survey and the Ames Research Center of NASA.

Figure 4. Typical specimens of coesite-bearing shocked Coconino sandstone from Meteor Crater, Ariz. E. C. T. Chao (left), E. M. Shoemaker (right). Note the "shear" openings nearly perpendicular to the bedding of the specimens.

In May 1960 one of Shoemaker's specimens was sent to the Geological Survey Laboratory in Washington, D. C., where E. C. T. Chao made a detailed petrographic examination. He noted that in thin section the quartz grains were strongly sheared and imbedded in a fine-grained matrix which George Merrill in 1907 reported to be opal or some sort of silica glass. But Chao observed that the index of refraction of the matrix material was higher than that of the fragmented quartz. Suspecting either a most unusual glass or a mixture of very fine grained minerals, he made a standard X-ray powder pattern film of the matrix material. Quartz lines were readily recognized on the film and the additional lines were identified as coesite—an exciting discovery. Ed Chao then proceeded to obtain the optical constants of the mineral as further evidence.

To verify the identification and to cover all loopholes, Survey colleagues Brian Skinner, Joseph Fahey, and Harry Bastron then came through with able assistance. Skinner fortunately had, for comparison, a powder pattern he made some time ago of synthesized coesite obtained from F. R. Boyd. Brian immediately made and analyzed some diffractometer runs on the quartz-coesite mixture and, later, on the purified coesite, thus corroborating Chao's original identification. Fahey employed his talents in chemically treating samples with HF to obtain a purified concentrate of coesite, which Bastron then analyzed spectrochemically to report 99+ percent Si and less than one percent other cations. While these surgeons were slicing away, the news was telephoned to Shoemaker at Menlo Park, where he and Beth Madsen then identified coesite by X-ray study in other speciments of sheared Coconino sandstone collected from different parts of the crater. The telephone was used frequently by Chao and Skinner in discussing the discovery with Joe Boyd who, with Gordon MacDonald, later examined the sample material and the raw laboratory data during a visit to the Survey.

As well as any other example, this account illustrates the great importance of the X-ray and telephone to modern mineralogists. Like Merrill's original specimens in the U. S. National Museum, coesite-bearing Coconino sandstone from Meteor Crater probably can now be unearthed in many museum collections throughout the world.

It is a legend among the Hopi Indians that one of their gods descended from space in fiery grandeur to rest beneath the ground at the site of Meteor Crater. Rock flour (finely powdered white silica) was gathered by them at the crater and used in their ceremonies. Thus the Indians, long before geologists, were the first collectors of coesite.

Diamonds at Meteor Crater

A. E. Foote in 1891 reported the occurrence of fine-grained diamonds in iron meteorites found in this region. Lipschutz and Anders,[8] University of Chicago, as a result of their study of diamond-bearing meteorites, supported H. H. Nininger's

contention that the diamonds near Canyon Diablo were formed in the meteorites by a shock wave upon impact with the Earth rather than in a parent lunar or planetary body that later disintegrated. They cite metallographic evidence to show that these iron meteorites were reheated to about 950° C. for 1 to 5 seconds after they had attained their present, small size.

Sintered coesite-bearing rock at Meteor Crater would indicate a temperature maximum probably in excess of 1,000° C. with a pressure minimum probably in excess of 20 kilobars. The conditions attending coesite formation support the hypothesis of Nininger and Lipschutz and Anders.

Impact Metamorphism

The formation of coesite and diamond through meteoritic impact leads us into the broader concept of "impact metamorphism." Perhaps dense phases of other minerals will also come to light in a restudy of this and other impact craters. It seems a sure bet that coesite will be identified at other crater localities in quartzose rocks. The question that confronts us is whether or not coesite will prove to be an "index mineral" only of impact craters because of the pressure-temperature requirements. One might expect yet to find coesite in fault zones or other deformed rocks that suffered repeated shearing. This is the task of the field geologist, certainly, but not without the mineralogist as his hand maiden.

Lunar Craters

The investigations by Shoemaker and by Dietz have rekindled interest in the belief that some prominent lunar craters may well be craters induced by falls of meteorites many times larger than that which occurred at Meteor Crater, Ariz. The photogeologic map of Copernicus (displayed at Copenhagen) by Shoemaker and Hackman illustrates features now recognized in impact craters. Experiments on hypervelocity cratering by scientists of the Ames Research Center of the National Aeronautics and Space Agency in collaboration with Survey scientists have been started in an attempt to explore this phenomenon and to provide necessary data for more precise formulation of mechanics of cratering by impact. If some lunar craters are indeed impact craters, and are formed in rocks containing free silica, then coesite and other dense mineral phases may well have formed on the moon.

Craters on the earth formed by meteorites hitting this planet at high velocity involve a geologic process heretofore little known. In addition to the land form produced we have much to explore in the areas of rock deformation and impact metamorphism. Many circular depressions of uncertain or of stated volcanic origin on earth will yet prove to be impact craters. It is encouraging and reassuring to state that space geology, therefore, really begins at home on earth.

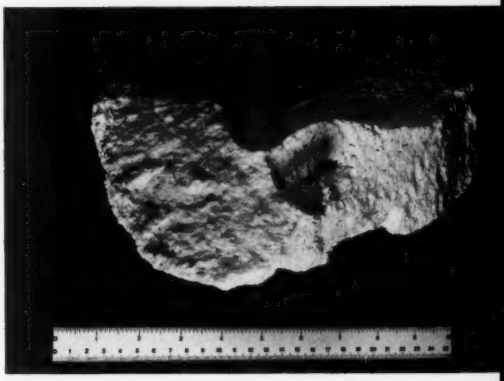


Figure 5. Naturally fused sample of Coconino sandstone from Meteor Crater, Ariz., containing large amounts of silica glass (lechatelierite).

Rieskessel Caldera

During revision of this manuscript for *GeoTimes* Ed Chao received in the mail specimens of "suevite" (pumaceous tuff) and "shocked" granite astutely collected by Gene Shoemaker near the rim of the Rieskessel caldera in Bavaria, Germany—a depression many times larger than Meteor Crater. Coesite was identified in the specimen by Chao. The geologic features of the Rieskessel caldera, whose floor measures 13 by 15 miles across, are summarized by Williams,[9] Bucher,[10] and Dietz.[11] If coesite indeed proves to be an index mineral specific to impact craters, rather than of shock-shear origin of whatever energy source, the startling coesite discovery at Rieskessel has great significance. Rubble on the floor of the Ries Plain is overlain by lake sediments of late Miocene age. This, then, the second of the "coesite craters" known, would be the first recorded in the pre-Pleistocene record. Perhaps the Shoemaker-Chao combination will reveal other coesite craters. We hope that geologists the world over are also stimulated to look for coesite and thus increase our knowledge of impact craters on planet Earth.

(Continued on page 32)

SCIENCE MANUSCRIPTS

a report by
F. M. Fryxell

A CONFERENCE ON SCIENCE MANUSCRIPTS, held at Washington, D. C., on May 5 and 6, was attended by more than fifty representatives of major scientific societies and other interested organizations in this country. Sponsored by the History of Science Society, this Conference was made possible by a grant from the National Science Foundation. The American Geological Institute was represented by the writer.

The two-day program, arranged by an Organizing Committee headed by Nathan Reingold of the Library of Congress, included prepared papers, comments on these papers, and open discussion. The general topics considered were: *"Presentation of the Problem," "Case Histories of Research Experience," "Role of the Archivist in the Preservation of Scientific Records," "What Shall We Save?"* and *"Solutions and Activities."* Proceedings of the Conference are to be published by the National Science Foundation.

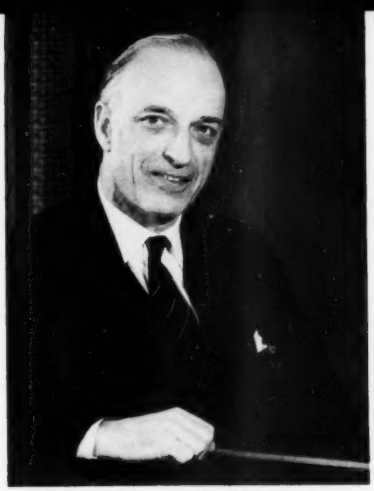
Program participants included Chauncey D. Leake, President of the American Association for the Advancement of Science; Henry E. Guerlac, President of the History of Science Society; Oliver W. Holmes, of the National Archives; Luther Evans, of the Brookings Institution; Robert P. Multhauf, of the Smithsonian Institution; Richard H. Shryock, of the American Philosophical Society; Hugh Odishaw, of the United States National Commission for the International Geophysical Year; A. Hunter Dupree, of the University of California; H. Bentley Glass, of Johns Hopkins University; and a number of other distinguished speakers.

It was generally agreed that there is a great need in this country for making a comprehensive inventory of the existing manuscript collections relating to the history of science; also that there is an urgent necessity for initiating a country-wide, uniform program, having for its purpose the preservation of contemporary science manuscripts, both for the use of historians of science and to give scientists themselves a background against which they can view, in proper historical context, their own increasingly complex and expanding problems. The preservation of records, it was emphasized, is important not only at the top echelons of science, among the academicians and award winners, but also throughout the rank and file of scientists, for example among local practitioners, workers in government and industry, and educators.

Establishment of an "Archives of American Science" was a suggested solution, but one that did not meet with general favor. However, some advocated creation of a centralized Commission, which might supervise whatever program is finally adopted. It was generally felt that the many archives already functioning—in colleges and universities, state and federal agencies, scientific societies and academies, corporations, and other organizations—could to a large extent meet the demands of the situation. A continuing, long-range program, such as that contemplated, envisioned the creation of additional archives where needed, and the aiding of depositories, old and new, with professional counsel and, so far as possible, material aid. It was agreed that the depositories could benefit greatly from the cumulative experience of organizations which have long dealt with archival problems, such as the Library of Congress, the National Archives, and the Society of American Archivists. A major aspect of the program would be the alerting of scientists, in all fields and throughout the country, to the importance of preserving significant science manuscripts—correspondence, administrative records, diaries and daybooks, maps, photographs, records of experiments, and other similarly pertinent documents—and providing for their proper disposition.

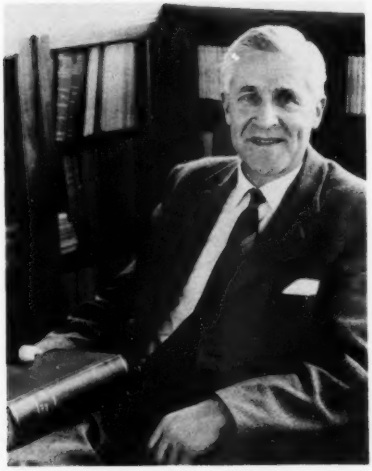
At the final session, it was resolved to perpetuate the Conference as an *ad hoc* organization until December, when it could convene in connection with the Annual Meeting of the American Association for the Advancement of Science, at New York City. The Organizing Committee was instructed to formulate a statement embodying the policies and procedures which had received favorable consideration in the course of the Conference, and to present this at the December meeting for further discussion. After adoption in final form, this statement will, presumably, be distributed to participating scientific organizations, which in turn can transmit it to their member societies and, through them, to the individual scientists. It is hoped that in this way helpful information and guidance will reach all organizations and persons concerned in any way with the preservation and use of science manuscripts.

It is self-evident that the program which this Conference has undertaken should



Above: DR. C. J. STUBBLEFIELD became the new director of the Geological Survey of Great Britain on August 1. He succeeds SIR WILLIAM PUGH who recently retired.

Below: DR. STEVENSON BUCHAN becomes the assistant director. Dr. Buchan visited in the United States during the past academic year on a lecture tour as a participant in the AGI Visiting International Scientist Program.



prove to be of great interest and significance to geologists. Those who have been concerned with the history of geology are particularly aware of how unsatisfactory are the present practices, for the most part, as regards the systematic preservation of the source materials with which they must work. The measures discussed at the Conference should lead to far-reaching improvements, among geologists as well as among their colleagues in other fields of science.

INDIAN OCEAN EXPEDITION

The July-August issue of GEOTIMES carried an article on the International Indian Ocean Expedition. Like the recent Internatitonal Geophysical Year, the International Indian Ocean Expedition will incorporate a many-sided scientific attack on a single area of interest under the leadership of a special committee of the International Council of Scientific Unions, a nongovernmental organization with headquarters in The Hague. Scientific responsibility for United States participation will be borne by the National Academy of Sciences–National Research Council, national representative to the International Council.

Acting upon the recommendation of the Federal Council for Science and Technology and the Special Assistant to the President for Science and Technology, the President approved a plan calling for key contributions by the Department of the Navy and the National Science Foundation. The Navy will make available oceanographic ships sponsored by the Navy and operated by leading United States oceanographic institutions. The Foundation will be responsible for planning and coordinating Federal support for United States participation in the program including the provision of financial support.

Responsibility for planning the scientific content of the United States program has been assigned by the Academy–Research Council to its Committee on Oceanography. The Committee has expressed the hope that the Expedition, in addition to its anticipated contributions to fundamental knowledge, will afford unusual benefits to the heavily populated, protein-deficient nations on the ocean's perimeter, both in terms of increased fish harvests and in the further training of local scientists and technologists in the techniques of oceanographic research.

The Expedition's peak activity is expected to occur during 1962 and 1963 when ships and scientific personnel from well over a dozen nations will be conducting basic research in physical and chemical oceanography, meteorology, marine biology, geophysics, and submarine geology.

Very little is known of the bottom topography and the geologic structure underlying the Indian Ocean, so that marine geological and geophysical observations will have an important place in the Indian Ocean Expedition. Old soundings delineate major structural components comparable to those of the Pacific and the Atlantic: trenches, undersea mountain

ranges, a mid-ocean swell, and possibly fracture zones. The arrangement of these components and their relationship to the structures of the bordering continents are markedly different in the Pacific and Atlantic. Is the Indian Ocean a Pacific or an Atlantic type ocean? Precise modern soundings, in addition to clarifying this issue, will be of immediate use in providing a base map for all the other studies and data necessary for navigational charts, and it is even possible that they may uncover rich shallow-water fisheries at considerable distances from shore. Integrated geophysical studies—of the areal pattern of heat flowing from beneath the crust, the gravity field, the crustal thickness, and magnetic characteristics of oceanic and border areas—will certainly furnish basic information for the problems of ocean and continent development.

Intensive coring, dredging, and bottom photography will yield data on processes of sedimentation, productivity, climatic, and magnetic changes during the last several millions of years and the distribution of potential ores of manganese, nickel, and cobalt in managanese nodules.

Summer Institutes in the Earth Sciences

Explosive is the word used to describe the population growth of the world. Explosive can also be employed to describe the growth and interest in earth sciences as a junior-senior high school science subject.

Explosive can further be applied to the interest of school science teachers in acquiring more background in the earth sciences to meet this new trend in science education.

Nearly 6200 junior and senior high school science teachers from all corners of the United States applied for participation in the institutes in earth science being sponsored by 12 colleges and universities during the present summer with the aid of grants from the National Science Foundation. Of the 6200 applying only about 400 teachers were selected for the 12 earth science institutes. In all, the NSF is supporting 380 summer institutes in science and math this year.

There is strong likelihood that the number of earth science institutes given NSF support will be increased in 1961 due to the obvious demand by teachers to improve their competence in these areas of science. Earth science institutes for high school science teachers in 1961 were expected to have available the Geology and Related Sciences Sourcebook developed by the Duluth Conference which was sponsored jointly by AGI and the University of Minnesota, Duluth during the summer of 1959. The sourcebook will be published by a major publisher of school text and reference books.

NUCLEAR WEAPONS TEST BAN REPORT

The Advanced Research Projects Agency (ARPA) in the Department of Defense and the Atomic Energy Commission are vigorously pursuing a research and development program (VELA) designed to increase understanding of the complex technical problems associated with a moratorium on nuclear tests. The ARPA-AEC Joint Committee on Atomic Energy has just released a 1,400 page report on "Technical Aspects of Detection and Inspection Controls of a Nuclear Weapons Test Ban" based on hearings held April 19-22, 1960. This report, a copy of which may be obtained from your Congressman, includes:

a. Technical Conclusions of the 1958 Geneva Conference of Experts.
b. Results of Technical Working Group II (Detection of Underground Explosions).
c. Berkner Panel Report on Seismic Improvement.
d. Discussion of Geneva Type International Control System with 1960 State-of-the-Art.
e. Capabilities of Monitoring Nuclear Tests During a Moratorium.
f. RAND Report on The Decoupling Phenomena.
g. Procedures and Techniques of On-Site Inspection.
h. Seismic Measurments of Large Explosions.
i. Highlights of the Department of Defense Seismic Research Program, 1948-1960.
j. Planned U.S. R&D Program for Improving Detection of Underground Detonations.
k. Results of the COWBOY Explosion Series.

One of ARPA's principal objectives is to increase rapidly over the forthcoming two years the understanding of complex technical problems associated with detection and identification of underground nuclear tests. To this end, ARPA welcomes unsolicited proposals that bear on solutions of this problem. Information on how such proposals might be prepared and submitted may be obtained by writing to *Advanced Research Projects Agency, Washington 25, D. C.*

KILAUEA IKI STILL UNDER OBSERVATION

The slowly cooling pond of molten lava in Kilauea Iki is providing Geological Survey scientists at the Hawaiian Volcano Observatory with a wealth of new data for their long-range studies, the Department of the Interior announced today.

A crust thick enough and cool enough to walk on has formed over the 2,500-foot diameter 365-foot deep lava pond following the November-December activity in Kilauea Iki crater. According to Jack Murata, scientist in charge, the entire Observatory staff is involved in exploratory work on it and under way are a series of geological, geophysical and geochemical experiments aimed at making the most of opportunities rarely available for study anywhere in the world.

By the end of April a hole 7⅞-feet deep had been put down into the crust with a small electric drill and a carbide-tipped bit. At that time the crust had solidified to a depth of about 10 feet and could be walked on freely. However the temperature at a depth of two feet was about 500° Fahrenheit. At four feet it was about 940° F., at six feet, 1250° and at 7⅞ feet, 1400°, indicating a variation of about 210° F. per foot. The hole has since been deepened to 12¾ feet by repeated cooling with water and drilling. Maximum temperature at the bottom is 1685° F., and a red glow is visible toward the bottom.

With the improvised equipment it is not possible to drill any deeper for the carbide-tipped masonry drill disintegrates at this high temperature. But it is quite apparent that molten lava must be only a few feet farther down.

A rain gauge was installed at the hole and it was found that temperatures in the uppermost three feet of the hole are markedly affected by rainfall. A second hole six feet deep was drilled for comparison. Other scientists, from the University of California at Los Angeles, are expected soon to accomplish additional drilling in Kilauea Iki using much more elaborate equipment.

Meanwhile, a geophysical team consisting of Jerry P. Eaton, Harold L. Krivoy, Burton J. Loucks, John L. Forbes, Akiro Yamamoto and William H. Francis, have continued making tilt measurements throughout the network of stations established in the vicinity. The measurements showed that between January 21 and April 1 subsidence of the summit in the vicinity of Halemaumau had attained the astonishing total of five feet. During the month of April, according to Jerry Eaton, "subsidence continued at a moderate rate."

Gravity measurements by Krivoy show an apparent correlation with filling and emptying of magma chambers beneath the summit.

Geochemists Wayne U. Ault and George Kojima experimented with methods of sampling gases which would maintain the same relative amounts of the components in equilibrium at the higher temperatures. In the course of this work they found that water plays an important role in the speed of the reaction between hydrogen sulfide and sulfur dioxide to form sulfur and water. In a wet sample the reaction proceeds rapidly to completion, but in a dry sample the reactants persist for about a day. How useful this discovery will prove to be in the over-all long-term vulcanism studies, is yet to be determined.

Ewing Awarded Petroleum Research Grant

The Petroleum Research Fund of the American Chemical Society recently announced a grant in the amount of $50,000 to Professor W. Maurice Ewing (GEO-TIMES, *April 1960*), Director of the Lamont Geological Observatory. The grant was unsolicited and is unrestricted in recognition of outstanding contributions of the Columbia University research team in basic research in the petroleum field. It is stipulated that the grant can be used for any purpose during a period of six years for aid in the pursuit of imaginative research in any field of pure science which may afford a basis for subsequent research directly connected with the petroleum field.

The Petroleum Research Fund is currently supporting over 350 research projects including the following which are geologically oriented:

J. K. Osmond, Florida State Univ., *Fluvial Sediment Dating*

W. S. Fyfe, Univ. of Cal. (Berkeley), *Mineral Systems*

Earl Ingerson, Univ. of Texas, *Translation of Russian Book on Dolomites*

J. V. Smith, Penna. State Univ., *Chemistry of Zeolites*

R. D. Russell, Univ. of British Columbia, *Earth's Crust Minerals*

G. J. Wasserburg, Calif. Inst. of Tech., *Helium-Argon Ratio*

D. M. Henderson, Univ. of Illinois, *Ancient Sediments*

Sam Houston Area Council scout executives Eldon Sehnert (left) and Minor Huffman (center) pose with geologist Bill Todd-Brown (right) at El Rancho Cima.

Houston Geological Society's

Boy Scout Acquaintance Program

by

Wm. E. Todd-Brown

In the late fall of 1959, there was a notice in the Houston Geological Society bulletin asking for volunteer geologists to aid in a Boy Scout Program. Mr. George Dickinson was the chairman of that committee and was the primary initiating force for the organization and direction of what was to become a monumental undertaking.

Response to the Bulletin appeal resulted in a meeting on December 2, 1959, of approximately 15 geologists, a professional Scouter, Mr. Eldon Sehnert, and other members of Mr. Dickinson's committee. The function of this first meeting was primarily organization. Certain individuals were asked to investigate the availability of rock, fossil and mineral specimens. Other individuals were asked to investigate motion pictures and slides that would assist in acquainting Boy Scouts in the rudiments of geology. It was also asked that each individual present give some thought to possible programs and a climaxing field trip. All endeavors primarily aimed towards two goals. Those goals were for a professional society to give of its time and resources to assist a group of Boy Scouts in becoming acquainted with the field of geology and its possibilities as a profession, and to aid those interested parties that may be desirous of obtaining the geology merit badge.

A tentative policy was decided upon at the next meeting which was held two weeks later. Since the Houston district covered such a large land area, it was divided into four parts, with a chairman and team of geologists for each. These teams were to meet in specified auditoriums for five or six weekly meetings, depending upon their program and attendance, to present lectures, slides, movies, or whatever other educational aid they might desire to achieve their purposes.

Certain latitudes were permitted each team in the number of meetings and the subjects of each. The author was chairman of one of these teams and it is believed that the program followed by that particular team would be fairly representative and is offered here for exemplary purposes. The first lecture was held on January 28, 1960. The expected attendance was from 30 to 50 boys. The actual attendance was in excess of 110 boys plus some uncounted adults. The next five meetings were held in a larger auditorium as a result of the unanticipated large attendance. One of the other teams anticipated possibly 75 boys and had over 200 present. It is extremely difficult to judge the attendance in a venture such as this, but in this instance it was gratifying to be in error.

What Is Geology

For the team being used here as an example, the program consisted of six meetings. The first meeting was a short introductory lecture on "What is Geology" with a motion picture to illustrate part of the lecture and a concluding five minute presentation outlining the next meeting. After each of the six sessions, there was a thirty minute question and answer period. At these question and answer periods the audience was divided into groups, depending upon the number of team geologists present. Thus, more questions were permitted to be asked and answered than if it had been handled on the basis of the lecturer alone responding to the group as a whole. It should be noted that often these question and answer periods ran over the thirty minutes allotted and in some instances continued into the street or drug store following the meetings. The questions were not confined

THIS IS THE STORY

Geologist leader of the Houston Society gets in a few licks with a group of interested scouts. Note the skeptical look on the face of the boy with the striped shirt—could there be another hypothesis?

SLOW!—MEN WORKING!

Geology-minded scouts looking for fossils swarm over a Mississippian outcrop near Marble Falls, Texas.

solely to the subject material, and oft times centered around a box of bones dug up by one of the boys, minerals collected by other boys, or some topic currently in the news, being related to earth science as a whole, however remotely.

The second lecture was on igneous and metamorphic rocks and minerals. During the lecture, hand specimens were passed through the audience. Oft times these specimens would shrink considerably during their pass through the audience. This was probably due to droppage or spalling. Displays were arranged at the back of the auditorium to supplement the lecture. Again, the same pattern was followed in the meeting in that there was a five minute preparatory talk for the following week's subject and the usual question and answer period.

The remaining meetings were carried out in the same manner and covered the following topics. The third was on erosion, sedimentary rocks and minerals. The fourth was on structure, mountains and land forms. The fifth was on earth history with a film and fossils galore. It was the observation of most geologists that to

NOSE BAG LUNCHES? NO—ROCK!

Sample bags were in evidence as the scouts visited a granite quarry at Town Mountain.

AN EMBRYO CAREER GEOLOGIST?

This scout is concentrating on his fossil collecting, geology pick in hand.

the boys the most interesting part of the lecture series and of the field trip that followed later had to do with fossils. The sixth and concluding meeting was on economic geology with a film and instructions for the field trip. At this sixth meeting, the boys were given the necessary papers for registration and parental consent and were instructed that the field trip attendance would be limited and would be based on their attendance at the lectures and on a first come-first served basis. The local Boy Scout headquarters in Houston handled the physical registration of the boys as well as the overnight housing and food for the field trip.

Scouts in the Field

A preliminary field trip was held on February 28 and 29 and attended by 20 people to choose the routes and stops and to prepare the guidebooks and maps. It was decided to break the group into three sections on the trip the boys were to take and to use opposite directions of travel for the largest sections thereby increasing the safety at road cuts and reducing the number of people present at any one outcrop at a given time. Section "A," under the direction of the author, consisted of three chartered buses, nine geologists, seven adult scout leaders, and approximately 110 Boy Scouts. This section left Houston, Friday afternoon, April 1, and proceeded to Bergstrom Air Force base to spend the first night. Saturday morning, Section "A" had breakfast at the Air Base and proceeded then through the Central Texas mineral region where outcrops of igneous, metomorphic and sedimentary rocks were visited, as well as various land forms were observed. Each bus was equipped with a public address system thereby permitting a running commentary to be made to aid in following the guidebooks and to acquaint the boys with what would be seen or visited next.

Section "A" passed Section "B" at midday and continued on to spend Saturday night at El Rancho Cima, a Boy Scout camp near San Marcos, Texas. Section "A" spent Sunday morning, after chapel, in collecting fossils on the ranch grounds and then returned to Houston early Sunday evening.

Section "B," under the direction of Dr. Robert Greenwood, followed the same route as Section "A," only in reverse. Section "B" left on Friday evening and spent the first night at El Rancho Cima and the second night at Bergstrom Air Force Base. Section "B" consisted of a like number of boys and personnel as Section "A" and arrived in Houston Sunday evening.

Section "C," under the direction of Pete Rose, left Houston at 5:00 A.M., on Saturday morning and followed the same route as Section "A" with approximately an hour's separation at the outcrops. Section "C" consisted of one bus, three geologists, two scout leaders, and approximately 36 Boy Scouts. Section "C" spent Saturday night at El Rancho Cima along with Section "A."

Because of the expense involved in chartering the buses, the overnight stop at Bergstrom Air Force Base and the food required, the boys were asked to pay a flat fee of $8.00 each. The balance of the money required was raised by solicitations on the part of the geologists participating from various companies and individuals. Approximately $1,000 was contributed from the Houston Geological Society's academic fund. This fund is maintained primarily by income from the Society's publications and from interests on investments.

To list all the persons connected with this venture would be formidable. Suffice it to say that there were 45 members of the Houston Geological Society directly involved in lectures and field trips. There were uncounted company personnel preparing samples, maps, slides and research. Major and individual producing, geophysical, service and pipeline companies supplied automobiles, phones, office equipment and money. The Boy Scout Officials and Scout Leaders arranged for safety, box lunches, dinners and quarters for all present. The Houston Geological Society, various companies, and individuals contributed cash in the amount of $1,925.00 to help defray expenses on the field trip so that the boys could have five meals, two night's lodging, and a 560 mile trip for the total of $8.00 cost to each of them.

It was a monumental undertaking in that the attendance at the lectures far exceeded the number anticipated. The work involved was tremendous, but the results were extremely gratifying. At the present time there is some discussion of a request that the program be repeated next year in two parts: one for the Boy Scouts and the other for the Girl Scouts. There has been a notable increase in the number of geology merit badges awarded in the Houston district, and the inquiries by those attending the lectures and field trips as to colleges and training facilities with respect to geology is extremely encouraging. It is the belief of those people involved that the purposes set out were recognized and this in itself is inducement enough to welcome the opportunity of a repeat performance.

GEOLOGY in the Public Eye

by
Robert L. Bates
Department of Geology, Ohio State University

Having been quietly minding its academic business for some 65 years, the department of geology whence this column emanates finally decided to take a modest little flyer in PR. (*As of course you know, PR is Public Relations.*) So, on a Saturday in May, we threw open the portals of Orton Hall and were hosts to 54 general-science teachers from the Columbus public schools. . . . The group assembled in a classroom, where they received a word of welcome and were shown a series of slides, with explanatory remarks, on *"What Geologists Do."* These slides, contributed by staff members, showed geologists on the outcrop, using the alidade, riding a Jeep, collecting fossils, down a hole in a glacier, and so on. There followed a 13-minute sound film, *"Continental Glaciers,"* which was produced a few years ago by Dick Goldthwait. . . . The teachers were then free to visit as they wished. Coffee was provided in the department library, along with a large number of free publications and maps which were avidly snapped up. The Ohio Geological Survey had an elaborate exhibit of maps and publications, with staff to answer questions and make sales. Air photos and stereoscopes were on hand, and received startled and delighted attention by a number of customers. . . . In the museum, the teachers peered at thin sections through a petrographic microscope and at microfossils through a binocular; heard Howard Pincus explain the mysteries of oscilloscope, geophones, and gravity meter; and goggled at an exhibit of rock specimens, photos, and equipment from Antarctica. . . . A few teachers went on a local field trip in the afternoon, but more attended a rock-and-mineral identification laboratory. They were allowed a modest collection of specimens that could be taken home. . . . The net result was almost unanimous approval by the teachers. (One complained because the film on glaciers went so fast she couldn't take notes.) They liked best the exhibits, free literature, and informal visits with the staff. Several expressed thanks for being accepted as co-workers rather than being talked down to. We plan future Open Houses, and we believe they will be well received.

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THE BERINGER CASE

JOHN E. SANDERS[1]

During my visit to the University of Bonn, Germany, in May, 1954, Professor Roland Brinkmann showed me a copy of the famous book, Lithographiae Wirceburgensis, by Johannes Bartholomew Adam Beringer (1726), as well as specimens of the Würzburg figured stones (Lügenstein) which formed the subject of this treatise. In response to my inquiry concerning the version of this case presented to German geology students, Professor Brinkmann replied in a vein quite at variance to the story I had learned in elementary geology in the United States.[2]

As I learned the story, Beringer is cited as an example of the quaint views earlier scholars held on fossils. He is portrayed as having fallen victim to a hoax allegedly perpetrated by his students. Beringer is held to have collected the figured stones in the field and to have considered them to be fossils. After amassing a considerable number of these objects, which portrayed insects, birds, sea horses, frogs, astronomical bodies, and the like, he wrote a book, Lithographiae Wirceburgensis (1726), describing and figuring them. After publication, the frightened students are presumed to have disenchanted Beringer by allowing him to discover the prank after they "planted" stones containing Hebrew characters and one containing his own name.

Aside from the other embellishments concerning his later actions, this version of the story concerns two points: 1) Beringer's students prepared and distributed the figured stones where Beringer would find them on field trips, and 2) Beringer thought the figured stones were fossils.

Kirchner questions both these points. As his paper is unknown in this country, the following summary of its findings is presented here, even though the paper is 23 years old.[3] Kirchner reports finding entries in the minute-book of the Würzburg town archives that extend and revise the former version of the story, which rests on a statement of Beringer's (1726, p. 83) that "three brothers, sons of a poor widow" were involved, and on an entry in the minute-book of the Würzburg cathedral, dated Saturday, 13 April 1726, concerning 3 youths from Eibelstadt.

The above-cited entry in the cathedral minute-book merely indicates the decision to collect evidence in the case; the actual hearings began on Monday, 15 April 1726, at the Town Hall in Eibelstadt (on the Main River, 10 km. southeast of Würzburg). The Town Clerk and two other officials questioned three youths: Nikolaus Hehn (18), his younger brother, Valentin (14), and Christian Zänger (17). The Hehn brothers admitted taking figured stones to Beringer, but they affirmed that they had refused to give such stones to the other townspeople, who were eager to have them, and they denied having any ability at carving figures. The subsequent investigation confirmed them in this.

Two adults are implicated by Zänger's testimony: Johann Gregory von Eckhart, Privy Councillor and Town and University Librarian of Würzburg, and his friend, Johann Ignatius Roderique, Professor of Geography, Algebra, and Analysis. According to Zänger, Roderique was the preparator of the stones. Zänger brought the raw material (limestone) to Roderique, who carved the figures and returned them, along with a special abrasive powder, to young Zänger for final polishing.[4] Afterward, Zänger (and at times the Hehn brothers) delivered the finished products to Beringer.

[1] JOHN E. SANDERS, Assistant Professor of Geology, Yale University, New Haven, Conn.

[2] I have tried to trace the origin of this version of the Beringer story; it seems to have first appeared in the literature in Zittel's History of Geology and Paleontology. No reference to the source of this yarn is given in Zittel (not even in the original German edition; the English translation lacks most of the references Zittel used in the German edition). Both Geikie in his Founders of Geology and Adams in his Birth and Development of the Geological Sciences essentially promulgate the Zittel version, slightly embellished. Though Adams consulted at least some parts of Beringer's book of 1726, neither Geikie nor Adams acknowledged his source of the story, a feature shared by elementary geology textbooks which include an account of Beringer. When he heard my account he mentioned that other facts had been uncovered which forced a reinterpretation of this view of Beringer. At the time, Professor Brinkmann could not recall the citation to the paper in which the new evidence was discussed, but I have since found it incidental to other work. It is: Kirchner, Heinrich, 1935, The Würsburg "false-stones" in the light of a new archival discovery: Deutsch, Geol. Gesell., Zeitschr., v. 87, p. 607-615, with one plate (30), showing 6 original specimens figured by Beringer.

[3] A few copies of a nearly complete translation of Kirchner's paper, prepared by the author with the help of Dr. Friedrich Brandtner, are available for distribution on request.

[4] ADAMS (*Birth and Development of Geological Sciences*, p. 260) states the stones were made by carving clay and baking it.

Roderique appears to have been a blaggard on all counts, for at one point Zänger requested the Town officials to force Roderique to pay him (Zänger) 8 days' wages for stone-polishing which were overdue!

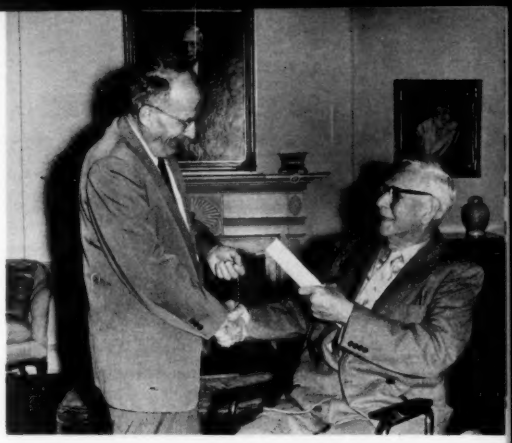
A later hearing was held on 11 June 1726; the testimony from it further implicated Roderique.

It seems to have been an open secret around Würzburg that Roderique was the preparator of the figured stones; the Prince-Bishop knew it, so even did Beringer, for one of the stones, at least. In Chapter 12, Beringer mentions that all these stones need not be considered the works of man merely because Roderique had prepared one which resembled the others.

Translation of Beringer's book by Professor Dederer, a philologist friend of Kirchner's, indicates what Beringer considered the figured stones to represent. In Chapter 13, Beringer argues for their natural origin, but interprets them as the work of inorganic agencies (such as are responsible for curiously formed concretions and the like, for example); he did not consider them to be true fossils or to be of organic origin. According to his own statement, Beringer possessed a large collection of fossils, but these figured stones were something different and special—not fossils. His purpose in preparing the book on these objects (statement at the close of Chapter 13) was to bring them to the attention of specialists who might be able to explain their origin. Though Beringer suggested analogies to these figured stones from nature, he admitted he did not know their true cause.

Beringer is regarded as one of the foremost scholars of his time and rejected typical 18th century views on the origin of objects dug up from the earth.

I have not yet been able to verify the rest of the Beringer tale—that he died in anguish and poverty after discovering the hoax and trying to buy back all copies of his book. It is clear from Kirchner's paper, however, that Beringer's adult colleagues instigated the trick (aided by three youths, but chiefly by Christian Zänger), that most of the stones were delivered to Beringer by the youths (Beringer did not himself find all of them in the field), and that he did not consider them to be of organic origin. Beringer was deceived to some extent, however, in that he failed to recognize these objects as the works of man; he held them to be due to natural inorganic agencies. How many of the rest of us have been deceived by believing and repeating a story about Beringer whose source and veracity we had not bothered to determine?



Honorary Membership to William E. Wrather

Dr. Wrather was elected to Honorary Membership in AIME in 1959. Unfortunately, since he is incapacitated and spends his winters in Florida, he was unable to attend the Annual Meeting in February 1960 and to receive his Certificate of Honorary Membership at the Annual Banquet. On June 3 President Gillson made a special trip to Washington to call on his old friend and present in person the Certificate. William E. Wrather is one of the outstanding elder statesmen of AIME.

CIM Gold Medal Award

The Canadian Institute of Mining and Metallurgy recently awarded the President's Gold Medal to Desh Bandhu Sikka, who recently received his PhD at McGill University, for his essay, *"Radiometric Survey, Redwater Oilfield, Alberta, Canada,"* which was judged the best paper in the C.I.M. Student Essay Competition for 1960. The paper was based on his research work of the past several years.

Mr. Sikka was born in Punjab, India and received his B.Sc. degree in 1945 in Pakistan. He obtained his M.S. in geology at New York University, before going to McGill to complete work for his doctorate.

The C.I.M. Student Essay Composition competition is open to all undergraduate and graduate students enrolled in a Canadian institution. The closing date is January 15, 1961. Further information may be obtained by writing the *Canadian Institute of Mining and Metallurgy, 1117 St. Catherine St. West., Montreal 2, Canada.*

MANPOWER *in a column —*

By HOWARD A. MEYERHOFF
Scientific Manpower Commission
1507 M Street, N.W., Washington 5, D. C.

The Engineering and Scientific Manpower Commissions are separate organizations, but they have coordinated their activities and cooperated in all matters of mutual interest since SMC was founded in 1953. Both Commissions seek support jointly from industry. EMC is wholly dependent on industrial contributions. SMC receives approximately 85 percent of its operating funds from industrial sources but depends on AGI and its ten other "nominating agencies" for the remaining 15 percent.

The recession cut deeply into EMC-SMC income, which, unfortunately, is not improving with economic recovery. SMC barely broke even in 1959—EMC operated at a deficit. Both face deficits in 1960. Continued deficits mean extinction, especially as every operating economy has already been adopted.

Among the staunch supporters of the two Commissions were several oil companies. This year one of the majors dropped out. We asked why, and the reason given prompts discussion.

"The Committee decided to discontinue support [because] the present situation with respect to manpower supply is not critical . . . if manpower circumstances were to change in future years, [the Committee] might reconsider its action."

Suppose we accept this statement insofar as it applies to geologists and geophysicists. In 1954 a completed questionnaire from this same firm showed that it also employed 100 chemists, 25 physicists, 5 mathematicians, and an unspecified number of engineers. The number of non-geologists was far in excess of its roster of earth scientists, and in all these other fields there are shortages of varying magnitudes. In engineering, the sophomore and junior classes are the smallest since 1952-53.

The present situation, therefore, is critical—unless a company is cutting back its professional working force in all departments.

Furthermore, this company's decision is, in effect, a disclaimer of any interest in, or concern with, the Manpower Commissions' other equally important responsibilities—judicious allocation of personnel between civilian and military requirements; representation of the scientific and engineering community as a whole before government agencies, education, and industry; promotion of sound precollege training for prospective scientists and engineers; collection of statistics on supply and demand; public dissemination of current facts regarding manpower.

An abandoned mine cannot easily be reopened. Nor can these services, if discontinued, be readily restored.

Espenshade Heads Earth Science Division: Hoover Is Executive Secretary

Professor Edward B. Espenshade, Jr., began a two-year tour of duty as the new Chairman of the Earth Science Division of the National Academy of Sciences–National Research Council in July, succeeding John N. Adkins. Professor Espenshade is Chairman of the Geography Department at Northwestern University. Among his many duties as Chairman of the Earth Science Division, Dr. Espenshade becomes a member of the AGI Executive Committee, representing the Academy.

As of July 1, Dr. Linn Hoover, previously with the U. S. Geological Survey in Washington, became Executive Secretary of the Division. Dr. Adrian Richards, who has been serving as Acting Executive Secretary while on leave of absence from the U. S. Hydrographic Office, returned there on July 18.

University of California at La Jolla

The Board of Regents of the University of California has recently added a graduate school of Science and Engineering at the La Jolla campus. Beginning in the coming academic year, graduate curricula will be offered in Physics, Chemistry, Earth Sciences and Biological Sciences. The Scripps Institution of Oceanography will maintain its role (on the La Jolla campus) as a research institute concerned with all aspects of the marine sciences, with a number of its faculty also holding appointments on the graduate faculty in the School of Science and Engineering. There will be a Department of Oceanography and a branch of the University's statewide Institute of Geophysics to be headed by Walter Munk.

Two new buildings have been erected on the La Jolla campus to house the new graduate School of Science and Engineering.

Popular Geology in print

by Mark W. Pongborn, Jr.

In the recent flood of books on prehistoric life, suitable for ages 8 to 12, three are outstanding. As one might expect, *Carroll L.* and *Mildred A. Fenton's* PREHISTORIC ZOO (Doubleday, 1960, $2.50) is both accurate and informative, a picture book with easy text describing some 60 mammals, birds, and reptiles, and arranged systematically rather than chronologically; the excellent drawings are generally based on those in "The fossil book." Another old hand at popularization, *Roy Chapman Andrews,* has simplified his fine "All about dinosaurs" into IN THE DAYS OF THE DINOSAURS (Random House, 1959, $1.95); after introducing his audience to some paleontological principles, Andrews vividly depicts a few of the more spectacular species in their native haunts, and then takes us on a dinosaur hunt in the Gobi. The third title, also attractively illustrated, is DISCOVERING DINOSAURS, by *Glenn O. Blough* (Whittlesey, 1960, $2.50); Blough describes some important dinosaurs, then examines the role of the paleontologist in finding, preparing, and displaying the skeletons, and even lists museums which feature mounted dinosaurs.

Two new titles are recommended for ages 10 to 14. *Lois* and *Louis Darling's* BEFORE AND AFTER DINOSAURS (Morrow, 1959, $2.95) traces the evolution of the Reptilia into their various groups during the late Paleozoic and the Mesozoic; anatomical differences and improvements are nicely demonstrated, and the numerous pictures and diagrams are fine indeed. FROM BONES TO BODIES, by *William Fox* and expert *Samuel P. Welles* (Walck, 1959, $3), shows how the paleontologist reconstructs fossil vertebrates; part 1, "The paleo-detective at work," points out the basic similarities of vertebrate skeletons, then discusses the importance of teeth and feet; part 2, "Case histories," describes the discovery and reconstruction of three famous creatures: the Shasta bison, Archaeopteryx, and Protoceratops; adequate illustrations.

With the publication of JEFF CARSON, YOUNG GEOLOGIST (Dodd, Mead, 1960, $3), by a husband-wife team of geologists, *John* and *Jane Lemish,* our profession now has a career book in fictional form, suitable for high school use. The Lemishes trace young Carson's career from summer geology camp in the Tetons, through USGS field work in Nevada, to a mining geology job in Mexico; it all has a very authentic ring, and is most informative, but we wish that the characters were better developed, and that the rather tenuous story was less apt to get lost amid unnecessary details.

The Committee of 1000

provides vital support to AGI and GeoTimes

The Committee of 1000 for AGI-1960 is now an imposing roster of 599 names of persons or organizations supporting the Institute and its program in 1960 through a contribution of $10 or more. The support by this Committee has provided a very important part of AGI's financial support and has permitted the Institute to meet with increasing effectiveness the growing needs for service to the geosciences and geoscientists.

There is still time for you to make a contribution to aid in support of AGI in 1960. To facilitate doing this you may wish to use the envelope appearing in the center of the Jan.-Feb. issue of GEOTIMES. Your contribution is tax deductible.

RECENT ADDITIONS TO THE COMMITTEE OF 1000 FOR AGI—1960 *

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* Previous lists published in GeoTimes, March, April, May-June and July-August issues.

Friends of Pleistocene Visit South Dakota

a report by
Allen F. Agnew
State Geologist

The Midwest Friends of the Pleistocene held their 11th Annual Field Conference in eastern South Dakota on May 14-15, 1960, under the leadership of M. J. Tipton and F. V. Steece of the South Dakota State Geological Survey.

During two typical South Dakota sunny but windy days with a sizeable North Dakota contribution of fine solid boreal particles to the lungs of participants, 65 Pleistocene experts and others such as the writer enjoyed stopping 12 times to view geologic features.

The trip, which dealt with the *Coteau des Prairies* between the former Des Moines and James ice lobes, was concerned mainly with morphostratigraphy during the first day, beginning at Watertown in the northern part of the *Coteau*. The type areas of the Bemis and Altamont moraines in the Des Moines Lobe were visited, as was an example of the Altamont moraine in the James Lobe. The Lake Agassiz outlet at Big Stone Lake was briefly contemplated, as were ice abrasion effects in the nearby Milbank granite.

Farther south, between Brookings and Sioux Falls, two drifts were differentiated mainly on the basis of topographic expression, the Crooks plain and the Trent moraine.

Detailed stratigraphy made up the second day of the trip, which dealt mainly with pre-Wisconsin deposits. The Hartford cut northwest of Sioux Falls excellently exposed in 1946—which shows 3 tills, a gastropod-rich zone and another deposit, the Pearlette ash, and Wisconsin loess—is now badly slumped. However, drive-pipe samples from a 116-ft. hole drilled two weeks before by the State Highway Department showed the stratigraphy so clearly that this stop was perhaps the outstanding feature of the trip.

Geologists and soils experts buried their faces in freshly-spaded cuts and had a field day arguing about what the Sangamon and Early Wisconsin soils look like, to their own enjoyment and to the delight of the State Highway patrolman who chaperoned the trip. The rain came in torrents, but not until the day after the trip ended; it has effectively washed away much of the blood spilled at these exposures.

At the dinner on May 14, former State Geologist E. P. Rothrock was resoundingly acclaimed by the group for his work on glacial geology in South Dakota. We regretted the unavoidable absence of other recent Pleistocene stalwarts in the area, notably M. M. Leighton, H. E. Wright, R. F. Flint, and R. V. Ruhe.

The consensus seemed to be (1) that the trip was enjoyable for its variety, (2) that the morphostratigraphic units were generally well displayed, and (3) that some rather pre-Cary-ous stratigraphic correlations had been made.

COESITE *(Continued from page 19)*

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CORRECTION

In the July-August issue of GeoTimes, the Pergamon Press ad on page 44 carried a printer's error under Vol. 5 of the Monograph Series which read Clays and Clay Materials. The corrected item appears below:

Vol. 5

CLAYS AND CLAY MATERIALS

Proceedings of the Seventh National Conference on Clays and Clay Minerals. Editor: ADA SWINEFORD, Ph.D., State Geological Survey, University of Kansas.

A most comprehensive source of information on recent advances in clay mineralogy, stress crystal structure of clay minerals, alteration of feldspars, clay mineralogy of soils, morphology of clay particles, water vapor sorption, and diageneses. $8.50

GeoTimes regrets the error.

THE LAST 500,000,000 YEARS. 16 mm kinescope. Sound. Color. 27 minutes. 1959. Drs. Whitmore and Palmer of the U. S. Geological Survey here paint with a broad brush some scenes from the last half billion years of evolution's story. Starting with the Pleistocene epoch (in which man's life span on earth is likened to the breadth of a light bulb on top of the Washington monument) they describe several Tertiary mammals and show that increase in size has characterized some evolutionary trends. They then move backward in time past Mesozoic reptiles and Paleozoic amphibians to the simpler invertebrates of the earlier Paleozoic, telling something of the many changes in life, and the different configurations of the continents which have characterized our earth's history. They also describe some of the work of paleontologists, both in the field and the laboratory, and tell something of the objectives of scientific study. A well narrated picture, suitable for the general public, as well as elementary classes in historical geology. Originally filmed for the TV audience, this reel is now available for loan to schools and other educational groups upon payment of shipping charges. DISTRIBUTOR: *(temporary) Greater Washington Educational Television Association, Raleigh Hotel, 12th and Pennsylvania Ave., N. W., Washington, D. C.*

THE MODERN PROSPECTOR. 16 mm. Sound. Black and white. 15 minutes. 1959. *Reviewed by Oswald C. Farquhar.* Here are portrayed the separate roles of the prospector, geologist, pilot, and woodsman in a Canadian mineral search. A copper-lead-zinc claim is staked; a quarter-million dollars raised; maps prepared; electromagnetic, gravity, and self-potential surveys run; ground parties flown in; and the property drilled. Is the project worth further development? This well-written case history gives the background for a decision. Suitable for elementary classes in physical and economic geology, or geologic field methods. DISTRIBUTOR: *International Film Bureau, Inc., 57 E. Jackson Blvd., Chicago 4, Illinois.*

RUBEY HONORED

W. W. Rubey, Research Geologist, U. S. Geological Survey, was among those receiving honorary degrees at Yale University this past June.

Left to right identification of Honorary degree recipients posing with President A. Whitney Griswold of Yale, Monday, June 13, 1960.

Front row, left to right: Ch'ien Mu, Eugene Black, Pedro Beltran, President Griswold, Rt. Rev. Henry Knox Sherrill, Edward R. Harriman, Robert Penn Warren.

Second Row, left to right: Edward T. Hall, William W. Rubey, Rev. Franklin Fry, Joshua Lederberg, William S. Fulton, Dr. Walls W. Bunnell.

An honorary degree to Cole Porter was given "inabsentia."

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DEAR SIR:

This Department possesses a very good set of the bulletins of the Geological Society of America and we have recently tried to complete the set by purchase of missing issues. Despite all our efforts we still lack three copies and are wondering if you would be prepared to put a small appeal into *GeoTimes* on our behalf in case any reader is in a position to supply the missing bulletins. The ones we lack are: Volume 55, No. 10 (1944); Volume 56, No. 7 (1945); and Volume 64, No. 4 (1953). If you are prepared to do this for us we should be deeply grateful. We are quite willing to pay a reasonable price for these bulletins.

We enjoy *GeoTimes* very much and hope that your appeal for funds will lead to expansion of this useful magazine.

Yours truly,

H. B. S. COOKE
Dept. of Geology
U. of Witwatersrand
Johannesburg, Union of South Africa

DEAR SIRS:

In reference to Horoscope Magazine, Page 14, June issue, I wish to pass on the following information to you:

News of earth tremors in our own Rockies and on the other side of the world in India is likely to make headlines.

Kindly pass on the above information to qualified persons in those areas.

Sincerely,

GEORGE MATYI

GENTLEMEN:

In your May-June 1960 issue of *GeoTimes* on page 39, column 2, you have omitted the name of R. J. Pickering, who has also been awarded a Post Doctoral National Science Foundation Fellowship for study in the earth sciences at Stanford University, California.

Sincerely yours,

KEITH A. KVENVOLDEN
Stanford, California

GENTLEMEN:

Thank you for the two extra copies of "*GeoTimes*" for May-June 1960, and for pointing out your reviewer's favourable comment concerning our yearly summary of "Geological Research in Canada." Naturally it is gratifying to know that the work of compilation and summary is valuable. So far as we know the project is unique in the sciences in North America and perhaps it is a project that should be emulated.

Your comments are appreciated and we wish you continued success with "GeoTimes."

Sincerely,

J. M. HARRISON,
Director,
Geological Survey of Canada

ROCK CHIPS

by SANDSTONE SAM

It happened in GEOTIMES, *May-June 1960 page 14. "The School Science Teacher—A New Roll for the Graduate Geologist."*

• • •

It happens in Russia too . . . we quote from Izvestiya Akad. Nauk USSR, Ser. Geol., No. 4, 1960, p. 108 "jadeite-bearing metagravyvacks in California."

• • •

If you burn the candle at both ends, you may not be as bright as you think.

• • •

From a state survey report, "We believe the U.S.G.S. may be the only government bureau that no one gripes about."

• • •

The person who complains about the way the ball bounces is often the one who drops it.

• • •

CONSULTANT: An ordinary sort of chap who is at least 50 miles from home.

GLOSSARY OF GEOLOGY AND RELATED SCIENCES, J. V. Howell, Coordinating Editor, 325 pages, 1957. $6.00.

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DIRECTORY OF GEOLOGICAL MATERIAL IN NORTH AMERICA, second edition, 1957. J. V. Howell, A. I. Levorsen, with R. H. Dott and J. W. Wilds. 207 pages, $3.00.

If you need to find geological information, you can't do without this book.

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HYDRAULIC CONVERSION DATA

[Prepared by U. S. Geological Survey, Water Resources Division, 1959]

Volume

1 cubic ft.	=	7.4805 U. S. gallons	=	6.2321 imperial gallons	=	28.317 liters
1 U. S. gallon	=	0.13368 cubic ft.	=	0.8331 imperial gallons	=	3.7854 liters
1 imperial gallon	=	0.16046 cubic ft.	=	1.2003 U. S. gallons	=	4.5437 liters
1 liter	=	0.03531 cubic ft.	=	0.2642 U. S. gallon	=	0.22009 imperial gallon
1 cubic ft.	=	0.028317 cubic meter	=	0.000032957 acre-ft.		
1 cubic meter	=	35.3145 cubic ft.	=	0.00081071 acre-ft.		
1 acre-ft.	=	43,560 cubic ft.	=	1,233.5 cubic meters		
1 cubic mile	=	3,3792 million acre-ft.				

1 cfs-day = 86,400 cubic feet = volume of water represented by a flow of one cubic foot per second for 24 hours

Volume Conversion Factors

Initial Unit	Coefficient (multiplier) to obtain: cfs-days	Mil. cu. ft.	Mil. gal.	Acre-ft.	In. per sq. mi.
cfs-days	-	0.086400	0.64632	1.9835	0.037190
Mil. cu. ft.	11.574	-	7.4805	22.957	.43044
Mil. gal.	1.5472	.13368	-	3.0689	.057542
Acre-ft.	.50417	.043560	.32585	-	.018750
In. per sq. mi.	26.889	2.3232	17.379	53.333	-

Velocity

1 mile per hr.	= 1.467 ft. per sec.	1 ft. of head, fresh water	= 0.433 lbs. per sq. in. pressure
1 mile per hr.	= 88 ft. per min.	1 lb. per sq. in. pressure	= 2.31 ft. of head, fresh water
1 ft. per sec.	= 0.682 miles per hr.	1 meter of head, fresh water	= 1.42 lbs. per sq. in. pressure
1 ft. per min.	= 0.0114 miles per hr.	1 lb. per sq. in. pressure	= 0.704 meters of head
1 ft. per sec.	= 0.3048 meters per sec.	1 atmosphere (m.s.l.)	= 33.907 ft. of water
1 meter per sec.	= 3.281 ft. per sec.		

Pressure (0^{o} C - 32^{o} F)

Weight

1 cubic ft. of fresh water = 62.4 lbs. = 28.3 kilograms
1 cubic ft. of sea water = 64.1 lbs. = 29.1 kilograms

Additional copies of this data sheet may be obtained from the AMERICAN GEOLOGICAL INSTITUTE, Cost $0.10.

Data Sheet 19

Data Sheet 19, *Hydraulic Conversion Data*, has been prepared for the AGI Data Sheet Committee by the Water Resources Division of the U. S. Geological Survey.

A number of interesting data sheets are in various stages of planning under the direction of the Data Sheet Committee. Members of the Committee are as follows:

Richard M. Foose, Chairman
John E. Allen
William Beatty
Chester Longwell
Vincent McKelvey
George Thompson
Ian Campbell

Ideas for data sheets should be directed to Dr. Richard M. Foose, Chairman, Earth Science Division, Stanford Research Institute, Menlo Park, California.

Rates of Flow

1 cubic ft. per sec.	=	448.83 U. S. gallons p r min.
1 cubic ft. per min.	=	7.4805 U. S. gallons pe min.
	=	646.317 U. S. gallons per day
	=	10,772 U. S. gallons per day
1 U. S. gallon per min.	=	0.002228 cubic ft. per sec.
1 U. S. gallon per day	=	.000093 cubic ft. per min.
	=	0.13368 cubic ft. per min. = 1440 U. S. gallons per day
	=	.0006944 U. S. gallons per minute
1 cubic ft. per sec.	=	1.9835 acre-ft. per day
1 acre-ft. per day	=	0.50417 cubic ft. per sec.
1 acre-ft. per year	=	0.00138 cubic ft. per sec.
	=	723.98 acre-ft. per year
	=	365 acre-ft. per year
	=	0.00274 acre-ft per day
1 inch per hr. on 1 acre	=	a flow of 1 cubic ft. per sec. (approx.)
1 inch per hr. on 1 sq. mi.	=	a flow of 645.33 cubic ft. per sec.

Rate Conversion Factors

Initial Unit	Coefficient (multiplier) to obtain: Cu.ft.per sec.	Gal.per min.	Mil.gal.per day	Acre-ft. per day	Inches per day per sq.mi.
Cu.ft. per sec. (cfs)	-	448.83	0.64632	1.9835	0.037190
Gal. per min. (gpm)	0.0022280	-	.0014400	.0044192	.00008286
Mil. gal. per day (mgd)	1.5472	694.44	-	3.0689	.057342
Acre-ft. per day	.50417	226.29	.32585	-	.018750
Inches per day per sq.mi.	26.889	12,069	17.379	53.333	-

Miner's inch is a rate of discharge that has been fixed by statute in most of the Western States:

1 cubic ft. per sec.	= 50 miner's inches (Idaho, Kansas, Nebraska, N. Mexico, N. Dakota, S. Dakota)
1 cubic ft. per sec.	= 40 miner's inches (Arizona, California, Montana, Oregon)
1 cubic ft. per sec.	= 38.4 miner's inches (Colorado)
1 miner's inch	= .02 cubic ft. per sec. (Idaho, Kansas, Nebraska, N. Mexico, N. Dakota, S. Dakota)
1 miner's inch	= .025 cubic ft. per sec. (Arizona, California, Montana, Oregon)
1 miner's inch	= .026 cubic ft. per sec. (Colorado)

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Owens Receives Matson Award

Harold Owens, district Geologist for Humble Oil in Tallahassee, Florida, has been awarded the George C. Matson Award for the outstanding presentation of his paper *"Florida–Bahama Platform"* at the Atlantic City AAPG meeting in April 1960. Owens is the fourth recipient of the Matson silver trophy which will be presented to him at the 1961 meeting of the Association in Denver.

Fellowship to Dapples

Edward C. Dapples, Professor of Geology at Northwestern University was one of twenty seven scientists of the United States to be awarded Senior Visiting Fellowships in Science under the program of the Organization for European Economic Cooperation (O.E.E.C.) which is administered by the National Science Foundation.

Professor Dapples will visit the Universities of Lausanne and Geneva in Switzerland.

VOM BAU DER ALPEN, *by Hans Liniger, 1958, 236 pp., 60 figs., Ott Verlag, Thun and München, $5.00 U. S.*

This text is an introduction to the Geology of the Alps, written mostly for the non-specialist. With its many clear and typical drawings it may also serve those not familiar with the region as a quick introduction and guide. It also contains a good list of standard reference works and maps and, in addition, it mentions various recent papers on critical problems.

Liniger's book can be recommended as a text for the foreign language requirement. The German is clear and well written. G.C.A.

SEARCH FOR THE PAST: *An Introduction to Paleontology, by James R. Beerbower, 562 pp., 1960, Prentice-Hall, Inc., Englewood Cliffs, N. J., $7.50.*

An interesting introductory approach to paleontology which brings together the geologic and biologic aspects of the fossil record and discusses methods of study, interpretation and utilization of paleontologic data.

FEDERAL TAXATION OF OIL AND GAS TRANSACTIONS, *by Leland E. Fiske, 234 pp., 1959, Matthew Bender and Co., Albany 1, New York. $25.00.*

A very helpful reference on the federal tax aspects of exploration, development, and operation of oil and gas properties, with data on depletion, partnerships, corporations, valuation and other tax-involved matters.

SUBSURFACE MAPPING, *by Margaret S. Bishop, 198 pp., 1960, John Wiley and Sons, 440 Fourth Ave., New York 16, N. Y. $5.75.*

A helpful guide to the student seeking organized background data on subsurface mapping concepts and methods.

BEACHES AND COASTS, *by C. A. M. King, 403 pp., 1960, St. Martin's Press Inc., 175 Fifth Ave., New York 10, N. Y. $14.50.*

An interesting and comprehensive treatment of the processes at work on beaches and coastlines based on world-wide examples.

THE SEA OFF SOUTHERN CALIFORNIA: A MODERN HABITAT OF PETROLEUM, *by K. O. Emory, 366 pp., 1960, John Wiley and Sons, Inc., 440 E. 4th Ave., New York 16, N. Y. $12.50.*

A comprehensive treatment of the water, life, sediments, physiography, geologic structure and economic aspects of the Pacific Ocean off the oil-important coast of Southern California.

PALEOTECTONIC MAPS OF TRIASSIC SYSTEM, *by Edwin D. McKee and others, 33 pp., 9 plates, 1959, Miscellaneous Geologic Investigations Map 1-300, U. S. Geological Survey, Washington 25, D. C. $5.00.*

This is the second in this valuable folio series (15" x 22") bringing together the important geologic data on the Triassic System of North America.

MOLLUSCAN FAUNAS OF THE FLAGSTAFF FORMATION OF CENTRAL UTAH, *by A. LaRocque, 100 pp., 1960, Memoir 78 Geol. Soc. of America, 419 West 117th St., New York, $4.50.*

THE STORY OF EARTH SCIENCE, *by Horace G. Richards, 169 pp., 1959, J. B. Lippincott Co., Phila., $3.75.*

A book for the layman relating geology to fossils and minerals.

APPROACH TO ARCHEOLOGY, *by Stuart Piggott, 134 pp., 1959, Harvard Univ. Press, Cambridge, Mass. $3.00.*

An interestingly written book presenting the archeologists' approach to the investigation of the human past.

OUT OF THE SKY, AN INTRODUCTION TO METEORITICS, *by H. H. Nininger, 336 pp., 1959, Dover Publications, Inc., 180 Varick Street, New York 14, N. Y. $1.85.*

This is a re-publication of the first edition originally published in 1952, giving the past history of meteorites and theories of their origin, with numerous illustrations and references.

ELEMENTS OF CARTOGRAPHY, *2nd Edit., by A. H. Robinson, 343 pp., 1960, John Wiley and Sons Inc., 440 Fourth Ave., New York 16, N. Y. $8.75.*

A completely rewritten version describing the present day state of the art and science of cartography. The book will be helpful to the person wishing to obtain an over all grasp of map construction techniques.

geology." Half of this book is devoted to the history of geology in general and half to the history of geology in the U.S.S.R.

If we contemplate this period of forty years of historical studies we see that in its earlier phases the history of geology was studied by isolated individuals, then by small groups attached usually to a university or an institute and finally, from about 1948, by organized groups or departments. Thus a section on the history of geology was formed in 1949 at the Geological Institute and in 1956 it was made into a special department of this Institute under the directorship of Professor V. V. Tikhomirov. Another centre for the study of the history of geology formed at the University of Moscow under the leadership of Professor D. I. Gordeev. A semiperiodic publication entitled "Essays on the History of Geological Sciences" ("Ocherki po istorii geologicheskikh nauk"), edited by Tikhomirov and published by the Academy of Sciences, has appeared since 1953. Eight volumes of this publication have already been issued. They comprise some 1,900 pages and contain fifty-one long articles, seventeen shorter communications and eight bibliographies, the whole being a most valuable contribution to the history of geology. A large number of articles and notes on this subject also appear in other periodicals like *Priroda* (*Nature*). A great help to the historian of geology, as well as to the ordinary research worker, are the editions of the collected works of such great scientists as E. S. Fedorov, F. Y. Loewinson-Lessing, D. S. Belyankin, V. I. Vernadsky, A. E. Fersman and A. N. Zavaritzky. The Russian translations of some famous old books, such as the "Prodromus" of Nicolaus Steno, or the "Temple of Nature" by Erasmus Darwin, are of a great value to the historian of science.

In the Soviet Union all the most important scientific works published in the outside world are immediately translated and minor works are fully and adequately abstracted. In the countries outside the Soviet Union a negligible number of Russian books is translated and the abstracting system, with a few outstanding exceptions, is far from being adequate and satisfactory.

Postscript

The exigencies of space at my disposal and the vastness of the subject under discussion will, no doubt, produce in the reader of this essay an impression that it is all "bits and pieces," and that there is too much of "names dropping" and "running over the highlights." All this is perfectly true, but it is due entirely to the fact that the purpose is to present only the main outlines and the leading trends of the progress of geology in the U.S.S.R. in all its branches and in the main over the last four decades.

The main handicap for geologists outside the Soviet Union in obtaining information on the progress of geology in the Soviet Union is the language barrier. In general it is true to say that people who know Russian do not know science and people who are interested in science do not know Russian. A curious situation exists today. The Soviet authorities no longer help, as they did before the war, by publishing translations of scientific articles or providing summaries in English, French or German. In any case one cannot learn much from summaries. Before the war one of the most important Russian scientific journals, *Comptes Rendues* (*Doklady*) *Academy of Sciences of the U.S.S.R.*, used to publish a second edition consisting entirely of translation of the articles published in Russian. At the present time *"Doklady"* provides in English only a list of contents. Thus the sources of information about the progress of geology in the U.S.S.R. for those who do not understand Russian are very limited.

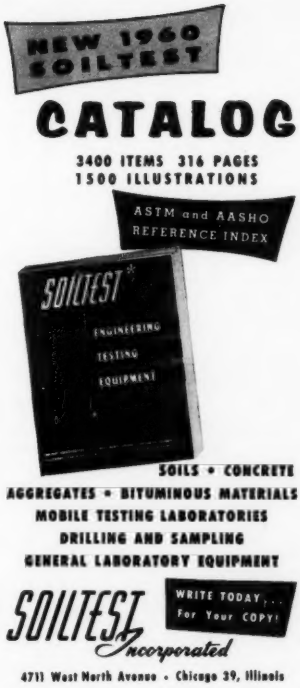
For those who know Russian the sources of information are as follows:—the Russian publications themselves, at the present time some 3,000 titles per annum comprising both a large number of books and a large number of journals, certain titles of which have been mentioned here in their appropriate sections; periodical Russian bibliographies, like that of *Geological Literature of the U.S.S.R.* published by the Gosgeoltekhizdat, e.g., the volume of this publication for 1952-53 (1955), contained 5,352 titles. Other bibliographies can be found in the "Essays" published by V. V. Tikhomirov, the reference to which was given in the preceding section. Then there is the *"Referativny Zhurnal,"* which began publication in 1952 (the geology section since 1954). This abstracting journal has a world wide coverage and publishes very lengthy abstracts, some 8,000 per annum of which, approximately 30%, will be of Soviet work. Then there are numerous reviews devoted to the progress of certain branches of geology, a number of them published in Tikhomirov's "Essays" referred to above. Quite a number of such reports were published recently in *Bull. Acad. Sci. U.S.S.R.* Ser. Geol., 1957, Nos. 11 and 12, and *Mem. All-*

Union Miner. Soc., 1957, Vol. 8, No. 5. Very compact reviews of the progress of geological sciences, as well as of other sciences, technology, arts, etc., have been published in volume 50 of the "Large Soviet Encyclopaedia" (1957), and are now sold separately.

For those who do not know Russian, the field of information is as follows:—*Bibliography and Index of Geology, exclusive of North America,* published by the Geological Society of America. *"Annotated Bibliography of Economic Geology,"* published by "Economic Geology," U.S.A. *Mineralogical Abstracts,* published by the Mineralogical Society, London (from 1920 to 1958 inclusive 2,665 abstracts of Russian books and papers have been published in the *Mineralogical Abstracts*), *Chemical Abstracts.* Two articles entitled "Geochemistry in the U.S.S.R." by S. I. Tomkeieff, published in the "Physics and Chemistry of the Earth," Vol. I (1956) and Vol. III (1959), Pergamon Press Ltd. These two articles cover the period 1948-1956. Occasional reviews and notes have also appeared in *Nature, Mining Magazine, Economic Geology* and *Geochemica et Cosmochimica Acta.*

In conclusion one may add that Soviet geologists are very proud of their modern progress as they are also conscious of their past. Here are a few extracts from an article written by a prominent Soviet geologist, D. I. Shcherbakov ("Soviet Geology during the last 40 years," *Bull. Acad. Sci. U.S.S.R.*, Ser. Geol., 1957, No. 11):—

"A completely new attitude to science has emerged in our state. Science has become an indispensable part of the whole creative, cultural progress and on the foundation of science all our life is being built." Then the author proceeds to enumerate all the great achievements of Soviet geology during the last four decades, such as the construction of new geological, tectonic and metallogenic maps, the extensive use of new methods of geological surveying—gravimetrical, magnetometrical, aerological, geochemical, and the method of deep stratigraphical boring. Then he mentions the development of palaeontology, stratigraphy and tectonics, as well as mineralogy, petrology and geochemistry. Finally he concludes: "As the result of widely applied and scientifically planned geological prospecting and surveying works over the vast expanses of our fatherland during the last forty years, there have been discovered all the types of mineral resources necessary for the development of our industry and agriculture. But the increasing tempo of the future economic development of all the peoples of our country presents increasing demands on the supplies of mineral wealth. Our Soviet geological science as past experience has shown, can, and must render real help. May, therefore, our geology, live, grow, and wax in strength!"



CHILE

An earthquake study team of geologists, geophysicists and engineers was sent to Chile for a two-week survey in mid-June for purposes of a preliminary observation and evaluation of the earthquake phenomena of the recent disastrous quakes. The team project is jointly sponsored by the Earthquake Engineering Research Institute and the California Institute of Technology aided by a grant from the National Science Foundation. Members of the team were Ray W. Claugh, C. Martin Duke, Karl V. Steinbrugge, James N. Jordon, and they were accompanied by Kiyoshi Kanai, prominent Japanese earthquake researcher. The group met with scientists in Chile in the survey.

INDIA *(Continued from page 15)*

	Employed	Unemployed	Research Students & Trainees	Retired	Total
Geologists	613	124	48	2	787
Geophysicists	60	9	14	—	83
	673	133	62	2	870

The annual out-turn of the geo-scientists of this standard is not high considering the country's mineral resources yet to be developed. About 150 geologists and 25 geophysicists are produced by the Indian Universities at the present time. The total strength of geologists would be around 1,700 and geophysicists 200 in the country.

Most of the employed geo-scientists in the National Register may be located in a few establishments—mostly governmental or teaching, as follows:

Establishments	Number of these enrolled in the N. R.		
	Geologists	Geophysicists	Total
Geo. Survey of India	154	7	161
Ind. Bureau of Mines	35	—	35
Oil & Nat. Gas Comm.	29	21	50
Collieries, Mines & Quarries	34	1	35
Petroleum Cos.	13	1	14
Atomic Energy Comm.	25	2	27
Cement Cos.	26	—	26
Iron & Steel Cos.	26	—	26
State Govt. Geology Depts.	37	—	37
Fuel Research Inst.	11	—	11
Teaching	169	18	187
Other Geo. work	33	8	41
Non-Geo. work	21	2	23
	613	60	673

Unemployment among the geo-scientists is relatively large, although those in employment draw comparatively better pay (see Technical Manpower Bull. May, '59). Among the unemployed, 43% are unemployed for less than 6 months, 44% for a period of 6-12 months, and 13% are looking for employment for over one year. This is as per their statement at the time of registration, and therefore indicative of the continuous period of unemployment they have already suffered. All of them are below 30 years of age, 85% below 25.

In addition, 3.4% of the employed geo-scientists are found wasted on work which does not require geological or geophysical knowledge, like subordinate clerical and accounts jobs, salesmanship and management of diverse undertakings.

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Elliott Medal to Romer

The Daniel Giraud Elliott Medal of the National Academy of Sciences was recently awarded to Dr. Alfred S. Romer, Alexander Agassiz Professor of Zoology and Director of the Museum of Comparative Zoology at Harvard University. The medal, established in 1917, is awarded for meritorious achievement in the fields of zoology or paleontology. The award was made in recognition of Dr. Romer's monumental monograph entitled *"Osteology of the Reptiles,"* a definitive study of reptilian skeletons. Dr. Romer, one of the world's outstanding vertebrate paleontologists, is especially known for his work on reptiles of the Permian and Triassic periods.

Aggregates Problem Cited

The Highway Research Board, meeting in Washington in late May 1960, defined 19 broad areas of highway research requiring concentrated effort.

The HRB, an organization operating under the National Academy of Sciences–National Research Council cited the critical shortage of suitable aggregates in some areas of the country. The shortage is aggravated by the accelerated demands. The Highway Research Board recognizes the need for greater soil stabilization research and other research which would contribute to alleviation of the aggregates problem.

AL-GEOLOGY

The Geological Society of Baghdad University has recently started a new geological magazine, *Al-Geology*. The magazine, which is a joint effort of the Science College, University of Baghdad, is about ⅔ in Arabic and ⅓ in English.

Geologists trying their hand at Arabic will find the English-Arabic dictionary of great interest.

GEOTIMES wishes this new magazine the best of success. We presume that the editors are just as plagued with typographic errors in Arabic as the GEOTIMES staff is in English.

K. G. S. Field Conference

The Kansas Geological Society will hold its 25th Annual Field Conference in Northeastern Oklahoma, September 16-17.

The field trip will be directed toward the study of the Atokan and Morrowan Series on the southwest flank of the Ozark uplift in Oklahoma and will be under the leadership of Dr. Jack Blythe of the University of Wichita. Headquarters will be at Western Hills Lodge, Wagoner, Oklahoma. For reservations contact *Harvel White, 508 E. Murdock St., Wichita, Kansas.*

Answer to Geologic Quiz

Just south of Monterey, Mexico. From the new "Carta Geologica de la Republica Mexicana". This beautiful full color wall map, size 47"x65" at 1:2,000,000 scale, may be purchased by writing Dr. Guillermo P. Salas, Instituto de Geología, Ciudad Universitaria, Mexico 20, D. F., Mexico.

Williams & Heintz Map Corporation Washington 27, D. C.

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- Bertrand lens: centerable
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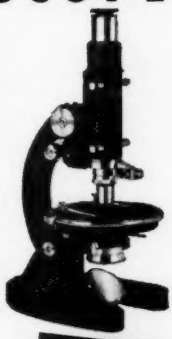
- Focusing: both coarse and fine



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NORTH AMERICAN MEETINGS

1961

Sept. 3-8—AMER. CHEM. SOC., 140th Meeting, Chicago, Ill.

Oct. 8-11—AIME: Soc. of Petroleum Engrs., Fall Meeting, Dallas, Texas.

Oct. 18-21—AAPG: Mid-Cont. Regional Meeting, Amarillo, Texas.

Oct. 25-27—GULF COAST ASSOC. OF GEOL. SOC.'S., Meeting, San Antonio, Texas.

Nov. 2-4—GSA: Ann. Meeting, Cincinnati, Ohio.

Nov. 5-9—SEGp: 31st Ann. Internat. Meeting. Denver, Colo.

Nov. 9-10—AAPG: Pacific Sect. Regional Meeting, Los Angeles, Calif.

Dec. 26-31—AAAS: Ann. Meeting, Denver, Colo.

1962

Feb. 18-22—AIME: Ann. Meeting, New York City.

Mar. 11-17—ACSM-ASP: Ann. Meeting, Shoreham Hotel, Washington, D. C.

Mar. 20-29—AMER. CHEM. SOC.: 141st Meeting, Washington, D. C.

Mar. 26-29—AAPG-SEPM: 47th Ann. Meeting, Civic Auditorium, San Francisco, Calif.

April——EIGHTH NUCLEAR CONGRESS, San Francisco, Calif.

April 23-25—CIM: Annual General Meeting, Chateau Laurier, Ottawa, Ont., Canada.

April 29-May 3—ACerS: 64th Ann. Meeting, New York City.

May 7-8—AIME: Soc. of Petroleum Engrs., 5th Biennial Secondary Recovery Symposium, Wichita Falls, Texas.

May 24-25—AIME: Soc. of Petroleum Engrs., Ann. Joint Meeting, Rocky Mountain Petroleum Sect's., Billings, Mont.

Sept. 9-14—AMER. CHEM. SOC.: 142nd Meeting, Atlantic City, N. J.

Sept. 17-20—SEGp: 32nd Ann. Internat. Meeting, Calgary, Atla., Canada.

Oct. 7-10—AIME: Soc. of Petroleum Engrs., Fall Meeting, Los Angeles, Calif.

Oct. 31-Nov. 3—GULF COAST ASSOC. OF GEOL. SOC'S., New Orleans, La.

Nov. 12-14—GSA: Annual Meeting, Houston, Tex.

Dec.—AAAS: Ann. Meeting, Boston, Mass. (tentative)

1963

Feb. 24-28—AIME: Ann. Meeting, Dallas, Tex.

Mar. 24-29—ASP-ACSM: Ann. Meeting, Shoreham Hotel, Washington, D. C.

Mar. 25-28—AAPG-SEPM: 48th Ann. Meeting, Coliseum, Houston, Tex.

April 22-24—CIM: Ann. General Meeting, The McDonald Hotel, Edmonton, Atla., Canada.

April 28-May 2—ACerS: 65 Ann. Meeting, Pittsburg, Pa.

May 23-24—AIME: Soc. of Petroleum Engrs., Joint Meeting, Rocky Mountain Petroleum Sect's., Denver, Colo.

Sept. 8-13—AMER CHEM. SOC.: 144th Meeting, New York City.

Oct. 6-9—AIME: Soc. of Petroleum Engrs., Fall Meeting, New Orleans, La.

Oct. (tentative) — AIME: Soc. of Petroleum Engrs., Meeting, Los Angeles, Calif.

Oct. 20-24—SEGp: 33rd Ann. Internat. Meeting, Roosevelt and Jung Hotels, New Orleans, La.

Nov. 13-16—GULF COAST ASSOC. OF GEOL. SOC'S., Ann. Meeting, Hot Springs, Ark.

Nov.—GSA: Ann. Meeting, Atlantic City, N. J.

Dec.—AAAS: Ann. Meeting, Milwaukee, Wis.

1964

Feb. 16-20—AIME: Ann. Meeting, New York City.

March 15-21—ACSM-ASP: Ann. Meeting, Shoreham Hotel, Washington, D. C.

March 31-April 9—AMER. CHEM. SOC.: 145th Meeting, Philadelphia, Pa.

May 4-5—AIME: Soc. of Petroleum Engrs., Meeting, Wichita Falls, Tex.

May 4-7—AAPG-SEPM: 49th Ann. Meeting, Detroit, Michigan.

May 18-21—AAPG-SEPM: 49th Ann. Meeting, Royal York Hotel, Toronto, Ont., Canada.

Aug. 30-Sept. 4—AMER. CHEM. SOC.: 146th Meeting, Chicago, Ill.

Oct. 4-7—AIME: Soc. of Petroleum Engrs., Fall Meeting, Houston, Texas.

Oct.——AIME: Soc. of Petroleum Engrs., Meeting, Los Angeles, Calif.

———GULF COAST ASSOC. OF GEOL. SOC'S., Ann. Meeting, Corpus Christi, Texas.

1965

Feb. 14-18AIME: Ann. Meeting, Chicago, Ill.

Mar. 29-April 3—ASP-ACSM: Ann. Meeting, Shoreham Hotel, Washington, D. C.

April 26-29—AAPG-SEPM: 50th Ann. Meeting, Municipal Auditorium, New Orleans, La.

May——AIME: Soc. of Petroleum Engrs., Meeting, Salt Lake City, Utah.

Sept. 12-17—AMER. CHEM. SOC., 148th Meeting, Atlantic City, N. J.

Oct. 3-6—AIME: Soc. of Petroleum Engrs., Fall Meeting, Dallas, Texas.

——GULF COAST ASSOC. OF GEOL. SOC'S,. Ann. Meeting, Houston, Texas.

1966

Feb. 14-18—AIME: Ann. Meeting, New York City.

LONG RANGE CALENDAR

This calendar has been prepared for several years by the AGI to aid in planning and scheduling of scientific meetings in geology and related sciences. Previously its distribution has been limited.

Henceforth, this calendar will be published twice a year in GeoTimes. We urge all concerned to provide concisely stated meeting notices for this calendar as soon as meeting dates become known.

Mrs. Kathryn Lohman
GeoTimes Calendar Editor
2101 Constitution Ave., N.W.
Washington 25, D. C.

INTERNATIONAL MEETINGS

1960

Sept. 5-17—INTERNAT. CONGRESS OF PHOTOGRAMMETRY, 9th, London, England. Col J. B. P. Angwin, Congress Director, 18 Cavendish Square, London, W. L., England.

Oct. 5-8—INTERNAT. COUNCIL OF SCIENTIFIC UNIONS, Executive Board Meeting, 12th, preceded by the Bureau's 24th Meeting, Palais Noordeinde 68, The Hague, Netherlands.

Nov. (2nd week)—PAN INDIAN OCEAN SCIENCE ASSOC., Congress, Karachi, Pakistan. Dr. M. Q. Khuda, Congress Sec'y., Director, East Regional Laboratories, Pakistan C.S.I.R., Polytechnic Institute, Tejgaon, Decca, East Pakistan.

SYMPOSIUM ON GEOCHEMISTRY, Gottingen, Germany. Internat. Union of Pure and Applied Chemistry, Section of Inorganic Chemistry, Commission on Geochemistry. Prof. Dr. C. W. Correns, Sedimentpetrographisches Institut, Lotzestrasse 13, Gottingen, Germany.

1961

Summer—INTERNAT. COUNCIL OF SCIENTIFIC UNIONS, 9th General Assembly, London. Palais Noordeinde, The Hague, Netherlands.

June—WORLD METEOROLOGICAL ORGANIZATION, Regional Assoc. III (South America), Session, 3rd, Rio de Janeiro, Brazil. Campagne Rigot, Av. de la Paix, Geneva, Switzerland.

July 17-22—INTERNAT. CONF. ON SOIL MECHANICS & FOUNDATION ENGINEERING, 5th, Paris, France. M. Buisson, Gen. Sec'y., Assoc. Francaise de Mech. des Sols et des Fondations, 31, rue Henri Rochefort, Paris 17e, France.

Aug. 21-Sept. 2—PACIFIC SCIENCE CONGRESS, 10th, Honolulu, Hawaii. Pacific Science Assoc. Secretary General, 10th Pacif. Sci. Cong., Bishop Museum, Honolulu 7, Hawaii.

Aug. 21-Sept. 2—SPECIAL COMMITTEE ON OCEANIC RESEARCH, 5th Meeting, Honolulu. Dr. Günther Böhnecke, Secy., Bernhard-Nochstr. 78, Hamburg 4, Germany.

August—INTERNAT. COUNCIL OF SCIENTIFIC UNIONS, 9th General Assembly, England or Portugal. National Academy of Sciences-National Research Council, Washington 25, D. C.

Sept. 18-23—III INTERNAT. CONGRESS OF SPELEOLOGY, Vienna, with excursions before and after the meetings. Write: Generalsekretariat des 3. Internationalen Kongresses für Speläologie, Verband österreichischer Höhlenforscher, Wien II, Obere Donaustrasse 99/7/3.

INTERNAT. ASSOC. OF PHYSICAL OCEANOGRAPHY, Symposium on Ocean Circulation. Prof. B. Kullenberg, Sec'y., c/o Oceanografiska Institutet, P. O. Box 1038, Göteborg 4, Sweden.

1962

July—INTERNAT. UNION OF CRYSTALLOGRAPHY, Celebration of the 50th Anniversary of the Discovery of X-Ray Diffraction, Munich. D. W. Smits, Gen. Sec'y., Internat. Union of Crystallography, c/o Laboratory of Inorganic and Physical Chemistry, 10 Bloemsingel, Groningen, Netherlands.

Aug. 27-31—INTERNAT. CONGRESS OF LIMNOLOGY, 15th, Madison, Wis., Dr. Arthur Halser, Chairman, c/o Dept. of Geology, Univ. of Wisconsin, Madison.

Nov.—INTERNAT. SOIL CONF., Palmerston North, New Zealand. Sec'y. Gen., P. O. Box 8001, Wellington, N.Z.

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POSITIONS WANTED

BOX 611. ASSISTANT PROFESSOR, Ph.D. major university wishes to teach in college or university in more desirable area. 3 yrs. teaching and 6 yrs. varied industrial experience. Primarily interested marine geology, paleontology, sedimentation, mineralogy. Active researcher, member prof. societies. Resume on request.

BOX 646. GEOLOGIST, broad exploratory background in the Four Corners, Panhandle and West Texas. Eight years experience includes subsurface, administration and seismograph. Some field and well work. Desires more responsibility.

BOX 730. PALEONTOLOGIST-STRATIGRAPHER. Desires permanent teaching position. 11 years teaching experience in paleontology, stratigraphy, sedimentology, historical geology. Publications. Available Sept. 1960.

BOX 738. GEOLOGICAL ENGINEER, 34, Ph.D., Univ. of Calif., economic geology, petrology, structure and vulcanology, adequate background, university teaching, several seasons mineral exploration and three years consulting, wants challenging teaching and/or research position.

BOX 746. GEOLOGIST, Ph.D., structural geology, sedimentary petrology, economic geology including exploration and evaluation techniques. Thirteen years experience in North and South America. Desires university position.

BOX 748. EXPLORATION GEOLOGIST, Ph.D. Degrees in mining engineering and geology. 10 years field work with Canadian Geological Survey and Quebec Department of Mines. Teaching experience in physics and geology. Publications, physics and geology. Professional engineer. Six years geologic exploration in Venezuela and Brazil. Desires foreign work.

BOX 749. GEOLOGIST, M.S. (1955), 32, family, urgently desires permanent position in the fields of either petroleum geology, teaching, mineral industry, ground water, or survey work. Good references and academic record. Recent recipient of National Science Foundation grant. Graduate work in hardrock geol-

POSITIONS WANTED—*Continued*

ogy and petrographic microscope. Professional experience: U.S.G.S.; 3 yrs. foreign employment in surface and subsurface petroleum geology; and college level geology teaching. Resume on request. Will appreciate interview opportunity.

BOX 751. GEOLOGIST, 34, Ph.D. Six years micropaleontologic, stratigraphic and petroleum exploration experience, both laboratory and field. Interested in teaching or general geological work with a small company or survey.

BOX 752. GEOLOGIST, B.A. Petroleum, M.A. Stratigraphy; foreign experience, Antarctic exploration, major oil companies; Arabic, English, French, Spanish; family; prefer Middle East, Latin America.

BOX 753. GEOLOGIST, M.S., 28, family, veteran. Hydrogeochemical and hyrdological background. Also computer and technical writing experience. Primarily interested in foreign work. Will consider domestic. Resume on request.

BOX 755. PETROLEUM GEOLOGIST, B.Sc., 28, single, 3 years with major company in petroleum exploration. Desires foreign employment in petroleum exploration. Resume on request.

BOX 756. WOMAN GEOLOGIST, hard rock, would like searches and report writing. An occasional field trip would be welcome. 14-year background in U.S., Newfoundland and Africa includes both bush prospecting and office geology at corporation headquarters. Currently employed in oil.

BOX 757. GEOLOGIST, B.S., '54, one year of graduate school prior to starting military obligation. Current USAF pilot, 1100 hrs. jet and multi-engine time, commercial pilot license, desires employment foreign or domestic starting in October. Interested in aviation connected with geology, aerial survey, aerial geologic reconnaissance and photogrammetry. Helicopter rating attainable.

BOX 758. GEOLOGIST, M.S., Ph.D. work completed, 32, married, veteran, 4 yrs. experience stratigraphic mineral deposits, sedimentology. Desires petroleum work domestic or foreign.

BOX 759. GEOLOGIST, 27, M.S., 2 yrs. experience with major oil company in Australia, Libya, speaks fluent French, considerable Italian, German, some Greek, Russian and Arabic; travelled extensively, 27 countries. Am pursuing one-year courses in physics and natural sciences at Univ. of Lausanne, Switzerland. Desires position, technical or personnel work, preferably in the petroleum industry; writing ability.

BOX 760. GEOLOGIST, 30, married, B.S. from University of North Carolina. 2½ yrs. military service, 2/Lt. U.S. Corps of Engineers. 5 yrs. experience in Petroleum Industry in production and exploration. Presently employed by Major Oil Co. Wishes to relocate. Seeks permanent job in Atlantic Coast States.

BOX 761. GEOLOGIST, 34, Canadian, family, 1958 Ph.D. from prominent California university, 10 yrs. excellent experience as staff and district geologist with large independent oil company, presently senior staff geologist. Desires permanent teaching post, preferably mineralogy, sedimentary petrology and related fields at university with good research facilities. Resume of experience, academic qualifications and publications on request.

BOX 762. GEOLOGIST-GEOPHYSICIST, B.S., M.S., Ph.D., specialist in location of stratigraphic traps with ability to interpret and compile seismic, geologic, and paleontologic data; experience in diverse geologic provinces; desire foreign position.

BOX 763. GEOLOGIST, MSc, 46, Broad Petroleum exploration and production experience in U.S. and Canada, formerly Chief Geologist and Exploration Manager, presently consulting. Desires teaching position at Uni. offering PhD. program or will consider any reasonable industrial offer. Presently located in SW.

BOX 764. GEOLOGIST, M.S. from Eastern University. Twelve years of experience in petrographic, geological and seismograph interpretative work. Desires employment in either of the above fields or teaching.

BOX 765. ECONOMIC GEOLOGIST, B.A. 6½ yrs. surface exploration, metallic, nonmetallic, industrial minerals, ground water evaluation. Subsurface studies, photogeology, recon and detail mapping. Some geophysics and geochem. Married, family.

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BOX 766, GEOCHEMIST-PETROLOGIST, B.S. in Chem., M.S., Ph.D. in Geology. Age 30, married, veteran. Experience in trace element distribution, X-ray and spectro-chemical techniques, igneous and metamorphic petrology. Prefer teaching position with opportunity to continue present research.

BOX 767. GEOLOGIST, Ph.D., currently substituting in temporary vacancy at major eastern university until June 30, 1961, seeks permanent position (assistant prof.), teaching petrology, structural geology, and allied subjects.

BOX 768. GEOLOGIST-MINERALOGIST, Ph.D., 31, family. Three years experience in major oil company research laboratory in fields of X-ray and fluorescence analysis, clay mineralogy and geochemistry of sediments. Broad graduate background in geology. Desires position at college or university. Available immediately.

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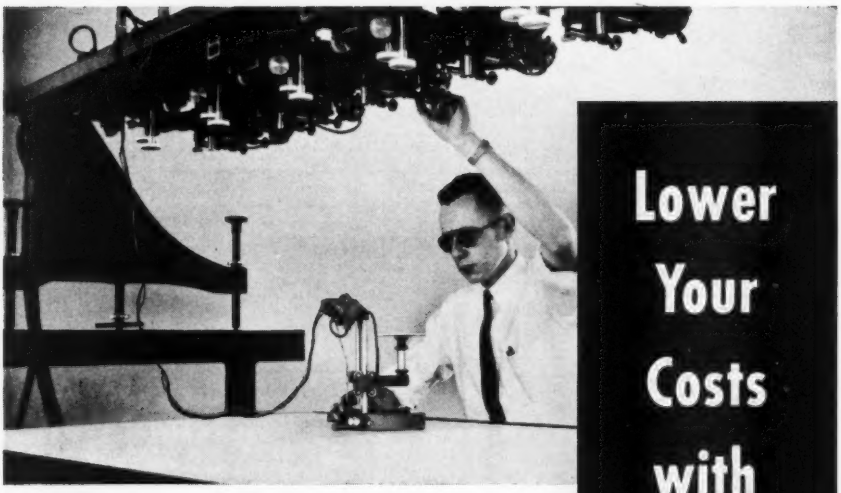
From the Department of Geology at Ege University, Bornova-Izmir, GEOTIMES has received a request to publicize the need of their department for contributions of instruments, equipment and all kinds of geologic literature, including periodicals, reprints, books and maps. Collections of rocks, minerals and fossils are also needed.

Persons interested in aiding in the building of the facilities of this department may contact *Professor M. R. Egemen, Dept. of Geology, Faculty of Agriculture, Ege University, Bornova-Izmir, Turkey.*



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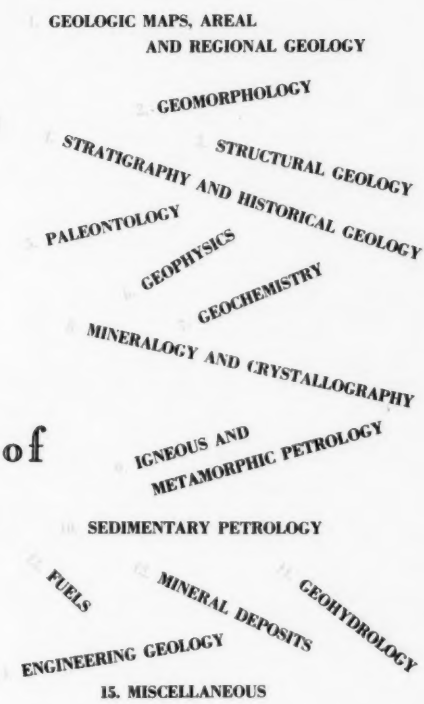

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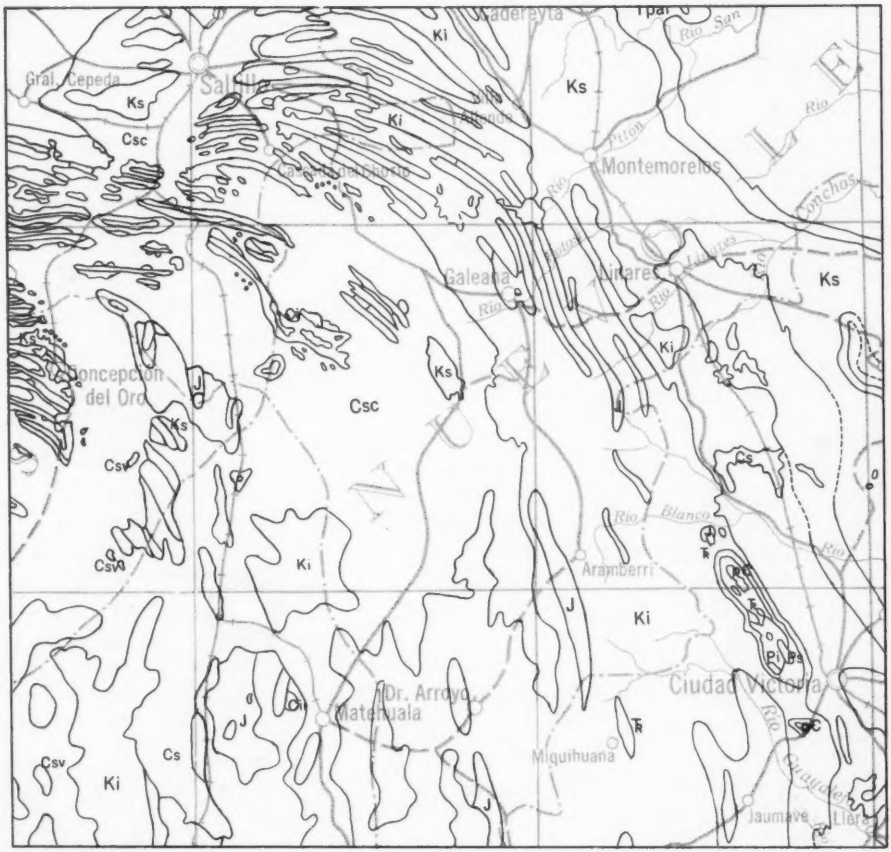
GEOLOGIC QUIZ No. 5

Where is it?



Obviously, from the Spanish names, this is somewhere south of the border but where?

See page 41 for answer.

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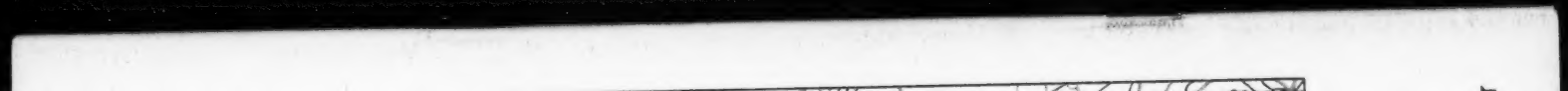
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